DOCUMENT RESUME

ED 434 953 TM 030 209

AUTHOR	Ronis, Diane
TITLE	Brain Compatible Assessments. K-College.
ISBN	ISBN-1-57517-168-6
PUB DATE	2000-00-00
NOTE	174p.; Foreword by Renate Nummela Caine and Geoffrey Caine.
AVAILABLE FROM	Skylight Professional Development, 2626 S. Clearbrook Dr., Arlington Heights, IL 60005-5310; Tel: 800-348-4474 (Toll free).
PUB TYPE	Books (010) -- Guides - Classroom - Teacher (052)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Brain; Cognitive Processes; Cooperative Learning; *Educational Assessment; Educational Research; Elementary Secondary Education; Instruction; Multiple Intelligences; *Neuropsychology; Standards; *Test Construction

ABSTRACT

This guide uses current brain research to show that some traditional instructional and assessment methods may actually work against the brain's natural way of learning. The guide shows how to enhance traditional methods of assessment using techniques derived from recent research on the brain. Practical approaches to assessment are illustrated with lesson plans that include opportunities for assessment. The following chapters are included: (1) "Instruction and Assessment"; (2) "The Assessment Revolution"; (3) "Assessment Formats: Standards, Design, and Brain-Compatible Learning"; (4) "Wiring the Curriculum: Standards and Their Technological Applications"; (5) "Multiple Intelligences and Brain-Compatible Assessment"; and (6) "Collaborative Learning." (Contains 41 figures and 84 references.) (SLD)

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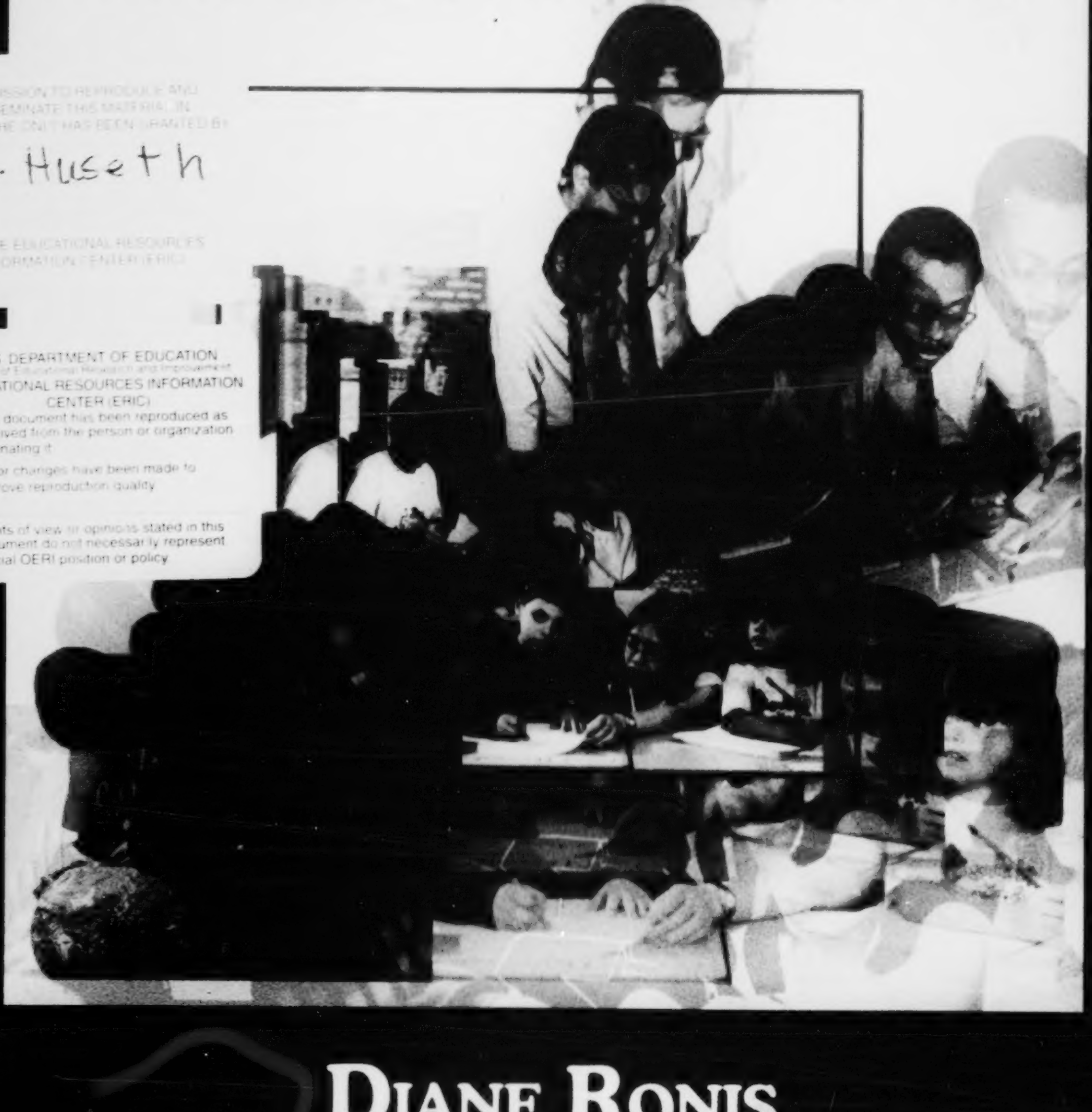

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DIANE RONIS

Foreword by Renate Nummela Caine and Geoffrey Caine

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BRAIN-COMPATIBLE ASSESSMENTS

Diane Ronis

SkyLight
PROFESSIONAL DEVELOPMENT
Arlington Heights, Illinois

Brain-Compatible Assessments

Published by SkyLight Professional Development
2626 S. Clearbrook Dr., Arlington Heights, IL 60005
800-348-4474 or 847-290-6600
Fax 847-290-6609
info@skylightedu.com
http://www.skylightedu.com

Director, Product Development: Ela Aktay
Acquisitions Editor: Jean Ward
Project Coordinator: Amy Kinsman
Editor: Peggy Kulling
Cover Designer and Illustrator: David Stockman
Book Designer: Bruce Leckie
Production Supervisor: Bob Crump
Proofreader: Cathy Shapiro
Indexer: Candice Cummins Sunseri

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Printed in the United States of America.

LCCCN 99-72787
ISBN 157517-150-3

2496-V
Item Number 1779
Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
06 05 04 03 02 01 00 99 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

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FOREWORD

To say that these are conflicting times in education and specifically for educational assessment is to greatly understate the degree of turbulence both inside and outside the classroom. Certainly the very least that everyone agrees on is that students need to know how to read well, write well, and do mathematics. Beyond those basics, the necessary skills required by tomorrow's workforce are very different from what most schools are still doing. Corporate trainers assure us that learning benchmarked only by paper and pencil tests will be sufficient only for those working at the lowest level of the workforce. As a participant at a Schools for the 21st Century Conference told us, "Imagine a situation in which a shipment is due at five o'clock on Friday evening and that the person receiving the shipment has clearly stated that if the shipment is not on the trucks at that time the order will be canceled. Now, further imagine that this shipment relies on a conveyor belt traversing four floors and that it breaks down at 4:15. The people we are looking for in that situation are not only the people who can fix the conveyor belt but also the people who can see alternative ways of getting the job done. And that person not only needs to see how to do things differently but this individual may not be the manager or person in charge." Companies are searching for individuals and organizational structures where employees are able to find creative solutions, work cooperatively, and adopt different roles and functions, and problem solve as a way of life. Real-life performance is the test.

How well do schools prepare such learners described above? And to what extent does assessment play a role in creating flexible learners who trust in their own ability to solve unique problems? As Diane Ronis points out in this book, today's schools still largely rely on standardization through standardized testing. For corporations looking toward the new century the landscape of learning looks very different and they are frustrated and alienated by the educational system that relies on nineteenth-century learning.

But what does learning look like when it is not tied to what Whithead (1979) calls "inert knowledge" and we call "surface knowledge"? In a rapidly changing world, learning means being able to live with paradox and ambiguity. It also means constructing not memorizing answers. Real learning is almost always a deep struggle involving the adjustment of beliefs and assumptions and inevitably engages issues of identity. Real learning is deeply personal. It requires that learners participate meaningfully in the ideas and subjects that they explore as they shape and reshape what they know and want to know. It requires that learners learn from genuine feedback.

But how do we understand such learning? How do we create it in our schools? And most important of all, how do we measure it? Diane Ronis has written an intelligent book that brings coherence and intelligence to understanding how to assess such learning.

She has framed her conclusions to some extent on a perspective based on a set of twelve learning principles that consolidate what is known of learning theory and include implications from the neurosciences.

The principles, as a whole, strongly suggest that learning is far more holistic, integrated, and complex when it occurs in real-life contexts. Learning includes the emotions, cognition, the context, the search for meaning, conscious and unconscious processes among others. The state of mind of the learner (including assumptions, conceptual frameworks) and beliefs all interact with learning.

Armed with this background, Diane takes on the task of assessment. She emphasizes that the learner needs to participate in the evaluation process and the need for what we call "active processing." Often teachers who teach through experiences and who create an empowered learning community, forget or do not know how to help students consolidate skills and knowledge that was gained during the experience. Such consolidation is process oriented and critical for continued and future learning.

The book also includes up-to-date thinking grounded in the field of assessment itself such as the development of rubrics, portfolio assessment, teaching for high standards. The author ties all of this to teaching examples. Diane demonstrates clear knowledge of what happens in classrooms all over this country and leads educators willing to take a leap in teaching and assessment.

What will happen, we predict, if educators follow her lead is that teaching and assessment will become part of the student's learning as they learn from everything including their own mistakes and corrections. They will pass standardized tests but will find such tests extremely limited and even embarrassing given what they can actually do.

When that happens schools will have aligned themselves with the challenges and opportunities that life in an interconnected global world calls for.

—Renate Nummela Caine, Ph.D.
—Geoffrey Caine, Ll.M.

PREFACE

The logic of it all, or lack there of, continues to elude me. Why is it that after years of hard scientific data containing the potential to revolutionize the way teaching and instruction are carried out, our educational system continues to revolve in the same old circles? Why, after it has been proven that the brain's true learning potential is actually thwarted and mishandled through the use of traditional instruction methods that fragment and dehumanize learning do we continue to use these methods? Questions such as these are continually being asked in my university education classes. My students do not understand why after being schooled in the logic of brain-compatible learning, they go into the field only to find they are expected to use textbooks that still cover ninety some-odd learner outcomes per year, and employ worksheets to reinforce this "learning." The answer that immediately comes to mind is the fact that our educational system, in spite of what scientific research has documented and proven, still "teaches to the tests."

Our nation continues to languish in the midst of a crisis of accountability. Our country's poor showing on tests such as the Third International Mathematics and Science Study (TIMSS), as well as the National Adult Literacy Survey (NALS), has only increased the hue and cry to get to the bottom of what we are "doing wrong." Unfortunately, the methods we are using to get to this bottom have been exacerbating the very problem that we have been striving so hard to correct.

America's infatuation with testing goes back to the early part of this century when the perceived need for a certain measure of objectivity in assessment gave rise to the "scientific testing movement." The result of this movement was the *standardized test*; a mass-produced, multiple-choice examination that could be administered to large numbers of individuals with consistent results. The standardized test became the assessment tool of choice for monitoring school quality and continues to drive the machine that prevents us from realizing student potential. As long as we continue to make our schools captive to tests that quantify learning according to standardized norms and sort students according to their abilities to memorize and spit back disconnected facts, true learning cannot flourish.

Real and enduring knowledge is much more than our ability to manipulate a mathematical formula out of context or recognize a list of word definitions. Real learning is about the learner's ability to apply learned skills to real-life, contextual settings. True understanding is best represented by the learner's ability to solve unfamiliar problems that have no clear-cut, neat answers, problems that are unpredictable and that entail an ability to extrapolate from existing knowledge to create novel and unique solutions.

The development of such knowledge cannot be ascertained through traditional assessment methods. The longer we continue to rely on large-scale, standardized tests as the single, most important indicator of learning progress, the longer we will find ourselves lagging behind our global counterparts. Each child, like a snowflake, is a unique individual with his or her brain preferring a particular learning style, possessing an array of intelligences, as well as sets of both learned and innate abilities. If each one of them is so singular, why do we insist on continuing to use a "one-size-fits-all" assessment method?

If assessment and "teaching to the test" are what drives the educational system, then it is time to make assessment the place to begin the motion of change. Educators must insist on using alternative assessment methods that are compatible with the way the brain learns and contain and employ rigorous standards and high challenge levels. Only then can veteran and fledgling teachers alike initiate the changes needed to educate our students to be successful citizens in the twenty-first century.

—Diane Ronis

INTRODUCTION

The Brain and Assessment Connection

The publication of the report, *A Nation at Risk* in 1983 made it clear that the United States was experiencing a crisis within its educational system. The purpose of the commission's inquiry was to analyze the "quality" of education in the United States as it then existed. The result, however, was to initiate dramatic changes in "traditional" public education and provoke a national preoccupation with quantifying educational achievement and assessing accountability (National Commission on Excellence in Education 1983). Unfortunately, many of the existing methods of assessing accountability are disconnected from what educators and researchers now know actually works to improve learning and comprehension. The standards movement serves as a good example. High standards for all students is a worthy goal; however, assessment and evaluation based on those standards are often incompatible with the way students learn.

Recent brain research has revolutionized the understanding of how the human brain learns. Traditional instructional methodologies actually work in opposition to the brain's natural way of increasing its knowledge base. Pat Wolfe and Ron Brandt highlighted the following key findings about the brain and learning in an article for *Educational Leadership* "What do we know from brain research?"

The brain goes through actual physiological changes as a result of experience. The environment in which a brain operates will determine, to a large degree, the functioning ability of that brain. (The environment affects how genes work, and genes determine how the environment is interpreted).

Intelligence is not fixed at birth. Studies have successfully demonstrated that early intervention programs can prevent children from having low IQs or mental retardation.

Some abilities are acquired more easily during certain "sensitive" periods, or "windows of opportunity." With PET (Positron Emission Tomography), brain energy use can be visually depicted. Through studies measuring such energy levels at different ages, peak learning periods have been scientifically ascertained. "Learning is strongly influenced by emotion. Strong positive emotions will make a learning experience more memorable whereas if the emotion is too strong (threatening) the level of learning will decrease." (Wolfe and Brandt 1998, 8–13).

Improving education in this country will require an array of changes focusing on attitudes, practices, and training. Many of the instructional methods U.S. educators have traditionally employed are working at counter purposes to the way the brain processes of information. By mistakenly focusing on the memorization of isolated skills and facts rather than inquiry and discovery involving connections and comprehension of underlying concepts, much of American education has been organized for failure. In brain-compatible classrooms, students are offered the kinds of learning experiences that teach knowledge organization, information synthesis, reinforcement of self-correction skills, and concept application. Such learning experiences demonstrate and employ the contextual application of new knowledge in much the same way these applications occur in real life, imbuing the content learning with relevancy and connection to the world outside the classroom. Brain-compatible learning focuses on solutions to problems that require reasoning rather than the repetitious memorization of bits of information. While all students should be held to rigorous standards, some may, indeed, need to achieve these goals through different and perhaps unconventional ways.

Today, America's educational system still remains "at risk." Some twenty-three million American adults continue to be functionally illiterate by the simplest tests of everyday reading, writing, and comprehension. What is occurring is a crisis of accountability. Why isn't the educational system working? Why aren't students learning? How is *real* learning measured? Can such learning be accurately quantified? This book tries to answer these questions.

Brain Compatible Assessments is presented in six chapters. Each chapter provides three OPPORTUNITIES FOR ASSESSMENT that provide a complete view of a full integrated assessment process and are designed as follows.

OPPORTUNITY FOR ASSESSMENT: *Title*

Level: Elementary, Middle, or Secondary with suggestions for modifications to accommodate other levels.

Content Standards: Are adapted from Robert Marzano and John Kendall's *Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education* (1996) and include standards from at least two disciplines. Suggestions for adaptations to other content areas are also provided.

Performance Standards: "Contextualize" content standards by identifying the manner in which they must be demonstrated and their expected level of performance or understanding.

Multiple Intelligences Learning Styles: Verbal, Visual, Logical, Musical, Interpersonal, Intrapersonal, Bodily, Naturalist. Based on the concept of teaching to student strengths; therefore, performance tasks exercise a number of the intelligences.

Performance Task: Each unique task while briefly stated conforms to the recommendations of Renate and Geoffrey Caine (1994) for implementation of brain-based learning in schools. All eighteen tasks

- provide variety and stimulation.
- encourage students to create products using their creative interests as the springboard.
- follow either the "small group" or "pair and share" model allowing for greater use of individualized learning plans that reflect distinctive learning styles, assorted intelligences, strengths, interests, and needs.
- have the teacher acting as the resource, facilitator, coach, and/or guide.

Assessment Technique: Rubrics, Observations, Student Self Assessment, and Portfolios are used. Each assessment technique is geared to best measure the particular performance task. Student performance samples are also offered where appropriate to illuminate expectations and to demonstrate "what excellence" should look like.

Chapter 1: Instruction and Assessment details recent neuroscientific findings and what these findings mean for education in general; how the standards dialogue influences brain-compatible learning theory and vice versa.

Chapter 2: The Assessment Revolution examines the history and reforms in the field of evaluation and assessment and calls for a new paradigm.

It explains what these reforms are and how they will change the face of assessment in the future.

Chapter 3: Assessment Formats: Standards, Design, and Brain-Compatible Learning focuses on the development, implementation, and assessment of student work. It details how to design brain-compatible assessments and why assessments that support metacognitive processing and collaborative project work also support brain-based learning.

Chapter 4: Wiring the Curriculum: Standards and Their Technological Applications deals with the technological revolution and implications for brain-compatible education. Included are discussions relating to classroom computer use, software selection, and navigating the Internet.

Chapter 5: Multiple Intelligences and Brain-Compatible Assessment focuses on the implications of MI theory on standards and assessment and why this theory is so brain-compatible.

Chapter 6: Collaborative Learning examines the most highly brain-compatible of the instructional strategies.

Through the use the OPPORTUNITIES FOR ASSESSMENT like the ones included in this book, students will discover that learning need not consist of the memorization of information having little or no application to their lives. Rather, they will be able to observe how high-quality learning and comprehension really involve exploration, discovery, conjecture, and relevance, based on rigorous yet authentic subject matter content. Teachers will find that assessments when ongoing and brain-compatible are indeed opportunities, opportunities for success.

CHAPTER 1

INSTRUCTION AND ASSESSMENT

A new way of thinking is required by the paradigm shift, but that way of thinking cannot be taught. The source of resistance to school change lies in a system that is itself maintained by a set of absolutely compelling deep beliefs about learning, teaching, and the nature of reality itself.

— Renate and Geoffrey Caine 1997, 26

The Pull of the Newtonian Paradigm

The term *paradigm* is used to describe the lens that orders, yet also limits one's perception and thinking. A paradigm consists of all those deeply held beliefs and ideas that shape the collective grasp of reality—a compelling frame of reference that has a life of its own. The term *paradigm shift*, then, refers to the process whereby persons are able and willing to change their viewing lens. Changing one's frame of reference is an internal process initiated by the individual when the rules and theories about his or her world can no longer account for the information being perceived.

The dominant view of reality for the past several hundred years has been decidedly Newtonian. The industrial era was marked by a mechanistic worldview grounded in ideas espoused by Sir Isaac Newton during the last part of the 17th century. One of the main aspects of the Newtonian paradigm was that almost everything in the world could be conceived of as machinelike. (Even the concept of solving a problem by "fixing it" is a mechanistic notion.) The goal of "fixing" human beings emerged as a corollary to Newton's theories and continues to influence ideas about instruction and education because it combines an explanation of reality with the supposed power to take charge of that reality. Under the mechanistic framework, problems are divided into distinct sections that are then "solved" in isolation. Behaviorism, a branch of psychology closely associated with education, is organized along such a framework and is characterized by the applications of rewards, deprivations, and/or punishments to control behavior mechanically. Gold stars, grades, training, detention, promotion, awards, incentive schemes, and penalties are the tools used to modify (fix) student behavior to conform (fit in) to society. The Newtonian paradigm served the world well during the Industrial Era when factories were the social and organizational models for schools. Today, however, the traditional organizational underpinnings of schools are being eroded, in part, because many of the larger systems that had formerly sustained education are now themselves changing or crumbling. Technological advances, scientific discoveries, and social change, call into question traditional ways of thinking about schooling and the bureaucratic structure that supports it. Even in the face of profound upheaval, most persons cling to a traditional set of beliefs in which only experts create knowledge, where the teacher's job is the delivery of this knowledge, and where students should be graded on how much of the information they are able to store and recall on tests (Caine and Caine 1997). Such beliefs continue to permeate all aspects of education, every decision, every meeting between teacher and parent, every budget deliberation, and every research study on teacher effectiveness. The information explosion coupled with the obligation of accountability is destined to cause the necessary paradigm shift.

Ironically, the catalyst of the information explosion, the computer, has also made possible the brain imaging technology that has provided a fresh understanding of the way humans process that information. Investigations into the neurosciences suggest that traditional and established methods of educating students actually inhibit rather than encourage their learning (Caine and Caine 1997). By discouraging, ignoring, or working against the natural learning processes of the brain, traditional didactic methodologies sometimes get in the way of learning and comprehension. Because the brain is intrinsically motivated by curiosity, it seeks out relevancy and connections. Passively receiving unconnected pieces of information through a lecture, or "telling," format does not always allow the brain to make the kind of connections it seeks to make. Patterns give context to information that would otherwise be dismissed as meaningless. Active processing and internalization of information gleaned through experiential learning creates the true path to understanding. Thus, it can be said that all meaningful learning is experiential. It follows then that grading, scoring, and ranking of individuals based on a stressful, one-time multiple-choice testing situation is antithetical to brain-compatible learning.

The Learning Climate Survey (see Figure 1.1) has been designed for use by teachers as a means for assessing the degree to which their classroom is either supportive of or actively interfering with brain-compatible learning. Any "yes" responses point to a particular aspect of the learning environment that needs revision or reevaluation to make it more brain friendly.

It is becoming clear that the evolving role of the teacher is to facilitate the creation of meaningful knowledge and understanding. Curriculum must be constructed as a scaffold upon which students stand and stretch to develop new abilities and meet new challenges. Instead of using traditional teacher-centered methods of instruction, a brain-compatible curriculum must be instituted. Brain-compatible teaching strategies monitored by brain-compatible

Learning Climate Survey: Is the Environment in Your Classroom Conducive to Brain-Compatible Learning?

	Yes	No
1. Letter or number grades used for evaluation purposes		
2. Fragmented and compartmentalized curriculum		
3. Class organization by age and grade rather than student readiness		
4. Most learning outcomes specified as behavioral objectives		
5. Lack of attention to alternative answers or solution strategies		
6. Intelligence narrowly defined, emphasizing mainly language and mathematics		
7. General indifference toward individual learning styles		
8. Lack of group participation and/or poorly developed student groups		
9. General indifference to student interests or how those interests might relate to subject matter		
10. Indifference to the use of student experiences as sources for curriculum connections		
11. Motivation guided by external rewards and punishments (grades) rather than intrinsic ones (student satisfaction of accomplishment)		
12. Teacher delivery of information dominates class time		
13. Constant or intermittent interruptions (bells, announcements)		
14. Lack of teacher and/or team planning time		
15. External pressures to teach, test, and move on regardless of student comprehension or understanding		
16. Prescribed or mandated curriculum		

Figure 1.1 Based on the work of Caine and Caine (1997)

assessments maximize the natural tendency of the brain to make connections and are thus the logical components needed to build the scaffolding students need.

Renate and Geoffrey Caine (1994) organized a learning framework from their vast research. When taken together, the following Brain-Based Learning

Principles demonstrate how the brain functions as a system for learning.

1. The brain is a living system.
2. The brain is a social brain.
3. The search for meaning is innate
4. The search for meaning occurs through patterning
5. Emotions are critical to patterning.
6. Every brain simultaneously perceives and creates parts and wholes.
7. Learning involves both focused attention and peripheral perception.
8. Learning always involves conscious and unconscious processes.
9. We have at least two different types of memory.
10. Learning is developmental.
11. Complex learning is enhanced by challenge and inhibited by threat.
12. Each brain is uniquely organized.

The following Integrated Brain-Compatible Learning Principles for Assessment Purposes link certain of the Brain-Based Learning Principles to those aspects of brain learning that specifically pertain to standards and assessment and are derived from the author's own work and experience. They concentrate on the aspects of brain research as it pertains to standards and assessment.

Principle 1: Every brain is uniquely organized, adaptive, and social.

Every person has the same set of systems but due to genetics and/or different life experiences, each person develops into a unique individual. The differences can express themselves in terms of varied learning styles, talents, and intelligences. (A discussion of Multiple Intelligence theory appears in chapter 5.)

Principle 2: Every brain is a device for both pattern-seeking and meaning-making.

Humans are innately motivated to search for meaning and relevancy. In general, the search for meaning refers to our making sense of all we experience. Although the ways in which individuals make sense of their experience change and evolve over time, the drive to do this always exists.

Principle 3: Every brain creates a personal perspective for meaning through connections created with the aid of the socialization process.

Verbal discourse creates individual sense-making, which in turn, allows connections to be made between new information and previously assimilated knowledge. It is only through observation, discovery, conjecture, reflection, and group discourse that new knowledge can be processed, assimilated, and internalized, becoming a permanent part of the individual.

Principle 4: For every brain the instinctive search for meaning occurs through patterning with emotions being critical to that patterning.

The search for meaning occurs through patterning. The brain needs and automatically registers the familiar while simultaneously searching for and responding to novel stimuli. The brain attempts to discern and understand patterns as they occur, and give expression to unique and creative patterns of its own. For education to be effective, learners must be given an opportunity to formulate their own patterns of understanding

Principle 5: For every brain, constructive challenge enhances learning while fear and threat hinder it.

The brain makes optimal connections when appropriately challenged in an environment that encourages risk-taking. When placed in a threatening situation however, other "emergency" systems override the brain's innate inclination to make connections and satisfy curiosity.

Principle 6: For every brain, learning is developmental, involving conscious as well as unconscious processes that build upon what is already understood.

While the brain is being shaped and transformed throughout life, there are predetermined sequences of development in childhood that include periods of sensitivity for laying down foundations for later learning. (The capacity of young children to acquire a second language is much greater than that of an adolescent or adult, for instance.) If such periods are ignored or overlooked, the abilities atrophy and will eventually be lost altogether. The brain's propensity for information seeking, processing, and organizing suggests that to capitalize on such propensities, instruction and information must be organized in a manner that is brain-compatible. Because emotion is also

INTEGRATED BRAIN-COMPATIBLE LEARNING PRINCIPLES FOR ASSESSMENT PURPOSES

1. Every brain is uniquely organized, adaptive, and social.

2. Every brain is a device for both pattern-seeking and meaning-making.

3. Every brain creates a personal perspective for meaning through connections created with the aid of the socialization process.

4. For every brain, the instinctive search for meaning occurs through "patterning" with emotions being critical to that patterning.

5. For every brain, constructive challenge enhances learning while fear and frustration hinder it.

6. For every brain, learning is developmental, involving conscious as well as unconscious processes that build upon what is already understood.

Figure 1.2

intrinsic to the education process, strategies for its inclusion cannot be neglected. Much of learning is unconscious, experienced as sensory input processed just below the level of awareness. Student comprehension may not occur immediately, but rather after the brain has had some time to process the information. It follows then that teachers need to incorporate both reflective and metacognitive activities into lessons. (Figure 1.2 is an overview of the six principles.)

Providing students with the guidelines for success before they undertake a task and the opportunity to work collaboratively with other students makes for the optimal emotional context for learning. The OPPORUNITY FOR ASSESSMENT #1: *Stellated Dodecahedron* illustrates how assessment can be ongoing and integral to the learning process. The activity applies an open-ended problem (the challenge of creating original three-dimensional shapes) while at the same time "testing" the students' ability to accurately use a ruler and protractor. This activity is presented as appropriate to the middle school experience but can easily be adapted to an elementary activity by having students use manipulatives, such as blocks or felt pieces, to create new shapes. The performance task can also be adjusted to suit secondary students by adding a documentation component where students write about their processes in creating the shapes. (The writing also allows the chance for student reflection and ultimately metacognition.)

Opportunity for Assessment #1

Stellated Dodecahedron

Level Middle

Content Standards

Mathematics (two- and three-dimensional geometry)

☐ Effectively uses a variety of strategies in the problem solving process
☐ Understands and applies basic and advanced properties of the concepts of geometry
☐ Understands the general nature and uses of mathematics

Language Arts (descriptive and reflective writing)

☐ Demonstrates competence in the general skills and strategies of the writing process
☐ Writes with a command of the grammatical and mechanical conventions of composition
☐ Demonstrates competence in general skills and strategies of the reading process
☐ Demonstrates competence in speaking and listening as tools of learning
☐ Demonstrates an understanding of the nature and function of the English language

Performance Standards

☐ Accurate and Careful Construction
☐ Shape and Symmetry
☐ Progress evident from practice
☐ Creativity

Multiple Intelligence Learning Styles

☐ Visual/Spatial
☑ Logical/Mathematical
☑ Verbal/Linguistic
☑ Musical/Rhythmic
☐ Bodily/Kinesthetic
☑ Interpersonal/Social
☐ Intrapersonal/Introspective
☑ Naturalist

Performance Task

Students learn methods for achieving accuracy with rulers and protractors. They then practice those skills by dividing a semicircle into five congruent, adjacent angles, each measuring 36 degrees. Once comfortable with the ruler and protractors, the students begin construction of the stellated dodecahedron model (a three-dimensional, twelve-pointed star). After completing the model, students are encouraged to create their own original, unique, three-dimensional shapes using the acquired knowledge of geometry and their own imaginations.

Assessment Technique

Portfolio Assessment—allows for a picture of the processes and improvement over time and allows for student work samples (see Figure 1.3).

DODECAHEDRON PORTFOLIO ASSESSMENT RUBRIC				
Qualities Evaluated	**Advanced** *Excellent and sophisticated work quality*	**Proficient** *Accomplished level of work*	**Basic** *Quality of work shows developing skill*	**Novice** *Beginning-level work quality*
Accurate and careful construction	Very precise and accurate	Most measurements are accurate	Some inaccurate measurements	Most measurements are imprecise or inaccurate
Shape/Symmetry	Completely symmetrical	Almost entirely symmetrical	Not entirely symmetrical	Distorted
Progress evident from practice	Each attempt is an improvement on the last	Each attempt marks improvement from the previous one	Improved from initial mistakes	No improvement evident
Creativity (original shapes)	Highly unique and inventive	Many elements of originality	Not entirely original design	No originality attempted

Figure 1.3

Emotions in Context

Traditionally, emotion and reason have been separated in the classroom. As a result, the day-to-day organization and management of schools may have been simplified, but sometimes at the expense of meaningful learning. Emotion and thought are connected at such a basic level that one cannot function without affecting the other. Emotions affect all learning since the stronger the emotion connected with an experience, the more powerful the memory of that experience. When emotional input is added to the learning experience, the brain remembers the experience as being meaningful and retention is increased. Emotion drives attention, which in turn drives learning and memory (Sylwester 1995). The more relevant a learning experience, the more the learner becomes emotionally involved in that learning experience, making "meaningfulness" a prime motivator in the learning process.

To maintain an optimal state of learning, researcher Robert Sylwester suggests in his book *A Celebration of Neurons* (1995) that the following are necessary for the future of meaningful and constructive education:

1. Accept and control emotions.

Emotions simply exist, they are not learned in the same way facts are, nor can they be easily changed. However, how and when to use rational processes to override problem emotions and hold them in check can be learned. Educators must move toward the recognition and the inclusion of emotions in the classroom dynamic; they must encourage dialogue as well as accept and deal with the emotions that accompany the resolution of problems.

2. Use metacognitive activities.

By focusing on metacognitive activities (those tasks that cause one to think about and reflect upon an experience) that encourage emotional verbalization and articulation, students will be more inclined to draw upon their own emotional references as a way of understanding the deeper motivation behind curricular goals.

3. Use activities that promote social interaction.

School activities that provide emotional support tend to emphasize non-evaluative social interaction and engage the entire brain and body in the activity. Physical and arts education are curricular areas where social interaction can most easily be promoted. Unfortunately, while such subjects enhance learning, they are often treated as frills, and are the first to be eliminated or curtailed when budgets get tight. (Most of the OPPORTUNITIES FOR ASSSESSMENT presented in this book involve cooperative group work.)

4. Use activities that provide emotional context.

Memory has the ability to trigger emotion. The reoccurrence of the emotional state in which a memory was formed will trigger the recall of that memory. Emotion-laden classroom activities such as simulations, role-playing, and cooperative group projects enable students to recall information during related events in the world outside the classroom. Anytime students are allowed to work and research a topic that interests them, they will be better able to recall that newly learned information when similar knowledge is needed in the future.

5. Avoid emotional stress.

An emotionally stressful learning environment reduces a student's ability to learn or process the information being taught. The use of on-going authentic assessment as one evaluation modality helps to reduce the level of classroom stress. While standardized tests do compare and contrast different programs or student populations, they are ineffective at measuring student growth or educational quality (Popham 1999). Alternative forms of assessment better gauge student abilities. (Chapter 2: "The Assessment Revolution" details the background and rationale for the use of alternative and authentic assessments in education.)

6. Recognize the relationship between emotions and health.

Emotion and health are closely related. Health education needs to address more than the healthy functioning of the body alone. The connection between a stimulating, emotionally positive classroom environment and the overall health of both students and staff must be included in the design of the curriculum.

The Need for Standards

During times of transition, like those in which teachers find themselves today, the need to define and set goals is of great importance. In the past few years, a lot of heated debate has taken place regarding the status of educational standards in the United States. While the need for standards is widely recognized, too often the standards being produced are lacking in measurable outcomes, contain vague language that refers to things that cannot be accurately assessed (such as love of literature), or are steeped in unrealistic expectations given available resources. While most states have formulated standards for education, few states have assessments that match their standards (Tucker and Codding 1998).

The following list delineates characteristics that states must include in their standards. Standards must

- be internationally benchmarked;
- describe a curriculum that can actually be taught;

- emphasize conceptual understanding and applications as well as basic knowledge and skills; and
- incorporate examples of student work that meet the desired standards.

To make standards compatible with brain-based learning, emphasis must be placed on inquiry and problem-solving methodologies over direct expository learning so that the brain's desire to organize information through pattern-making can be engaged. A learner's natural curiosity and desire to make connections can provide the intrinsic motivation that propels "good" learning. Students enjoy new learning when they are able to do it and when they can see how it connects to their world.

Workplace skills will increasingly include critical thinking, problem solving, cooperation, and teamwork. Solving real-world problems enables students to create their own original and viable solutions and strategies. Developing a good set of standards is only the beginning of building a quality standards-based education system. Assessment and accountability are integral to a successful standards-based system. Implementing problem-solving instructional strategies requires the development of authentic systems of assessment that measure cognitive and manipulative skills rather than traditional assessments that measure memorization skills. (Chapter 3 deals with assessment strategies in depth.)

Content Standards and Performance Standards

An influential report commissioned by the National Education Goals Panel, *Promises To Keep: Creating High Standards for American Students* (1993), offered a set of review criteria for academic content and performance standards. Among other observations, the report recognized two distinct types of standards—content standards and performance standards. *Content standards* define the knowledge (the most important and enduring ideas, concepts, dilemmas, and information) and skills (the ways of thinking, working, communicating, reasoning, and investigating) essential to each discipline. Standards thus far produced by states are in large part content standards. Content standards in and of themselves are difficult to use unless they are accompanied by performance standards. *Performance standards* specify "how good is good enough." They also indicate how competent a student demonstration must be to evidence attainment of the content standards. A performance standard has traditionally had three parts: the description, student samples, and commentaries. The description refers to what students must know and be able to do (the content standard). The samples of student work are to demonstrate the level and quality of work needed to meet that standard. And the commentaries on the student samples are needed to explain those features that raise the work to the particular standard level. The inclusion of student sample work is the key to making the standards usable by teachers, students, and parents. Any student should be able to look at a performance standard and say, "Now I understand what I need to do. I can learn to do that."

Teaching Methods and Instructional Materials

Content is a necessary and absolutely essential ingredient for the insurance of high-quality education for every student. However, content alone does not guarantee high-quality educational programs. Teacher methodology and style shape and influence what students learn. Because good teachers use different strategies at different times for different purposes, different and varied teaching techniques should also become part of the standards dialogue.

Good standards and assessments will inevitably create a need for curriculum materials that are matched to those standards. The needed curriculum materials will be very different from what is currently available. What educators need are materials grounded in content and based on brain-compatible instruction and assessment methodologies. Such materials would concentrate on only a few key concepts but would go into each of those concepts in depth. The materials would focus on enabling students to grasp underlying concepts. Texts would do a better job of helping students apply what they learn in the classroom to real-world, complex problems *without sacrificing any of the strength of the core disciplines.* The touchstone of such new curriculum materials would pay careful attention to the constant production of student work that meets the standards for that subject and grade level.

The OPPORTUNITY FOR ASSESSMENT #2: *Cartoon Creation* is another example of how student achievement can be assessed in a brain-compatible manner. Because there is no set answer and the uniqueness of a student response is prized over a student's ability to guess what the *teacher* thinks is a "correct answer," the activity works *with* the brain not against it. The performance task offered here is geared to the secondary level but can be easily re-framed to fit the standards for elementary and middle level students. Instead of examining economic systems (appropriate to the secondary level), elementary students can create cartoons depicting the various characteristics and types of human groups (families, villages, countries). Correspondingly, middle school students may construct cartoons that represent Federalist and anti-Federalist positions during the debate on the ratification of the Constitution.

Opportunity for Assessment
#2

Cartoon Creation

Level Secondary

Content Standards

Social Studies (economics)

- ☐ Understands characteristics of different economic systems, institutions, and incentives.

Language Arts

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Writes with a command of the grammatical and mechanical conventions of composition

Visual Arts

- ☐ Knows how to use the structures (e.g. sensory qualities, organizational principles, expressive features) and functions of art
- ☐ Understands the characteristics and merits of one's own artwork and the artwork of others

Performance Standards

- ☐ Understanding of economic concepts
- ☐ Creativity and originality of content
- ☐ Clarity of expression
- ☐ Cooperation and teamwork

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☑ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Student pairs create a cartoon showing the relationship between the economic systems of capitalism and communism.

Assessment Technique

Student Self-Assessment Outline (see Figure 1.4).

Economic Systems Cartoon
Student Self-Evaluation

Name ______________________________ Date ____________

How to Grade the Project

Were the economic concepts expressed clearly and accurately?
Was the cartoon well thought out, planned, and executed?
Was the cartoon neatly drawn?

How to Grade the Effort

Superior (E)
____My work was superior/excellent
____I made many positive contributions to the effort in every way possible
____I encouraged and assisted my partner when help was needed
____I was key to our success

Satisfactory (S)
____My work was complete and correct
____I made several positive contributions to the effort
____I encouraged and assisted my partner at least once
____I helped my group succeed

Unsatisfactory (U)
____I could have done better
____I did not help or encourage my partner
____I did not worry about the project
____I kind of goofed off

Explain the reasons for the grades you gave yourself below.

Figure 1.4

Student samples (see Figute 1.5).

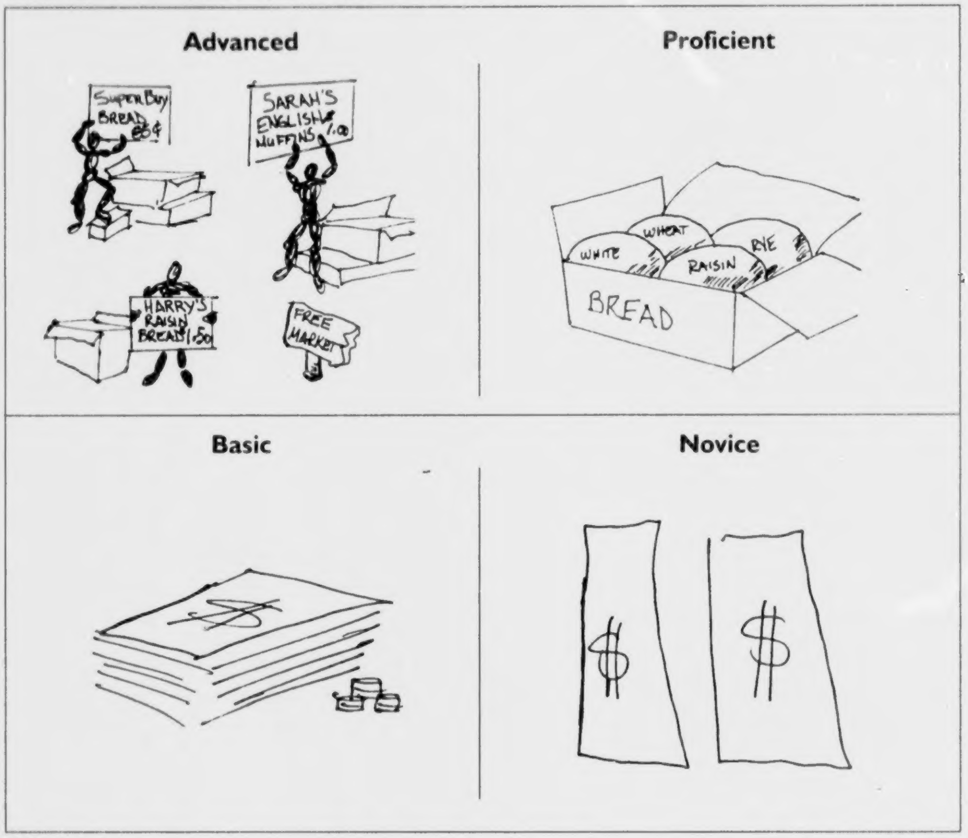

Advanced
Proficient
Basic
Novice
SuperBuy BREAD 85¢
SARAH'S ENGLISH MUFFINS 1.00
HARRY'S RAISIN BREAD 1.50
FREE MARKET
WHITE
WHEAT
RYE
RAISIN
BREAD
$
$
$

Figure 1.5

High Quality Standards

The American Federation of Teachers (AFT), the single largest group representing teachers in the United States, has developed a set of criteria for what it refers to as "high-quality" standards (AFT 1997). For each of the following eight AFT criteria, the implications and consequences of such criteria on a brain-compatible learning environment are offered by the author.

According to the AFT, standards must be:

Firmly grounded in academics

There first must be agreement among the general public, legislators, parents, and educators on which content students should be taught. Only then can energy and resources be focused on giving students the opportunities needed to improve reading and writing; to reach greater heights in math and science; and to learn more about history, geography, literature, and the arts.

Consequences for brain compatibility: The separation of discipline areas the AFT stresses works counter to the way the brain works. Such fragmentation hampers the making of connections that true learning and understanding require.

Based on the core disciplines

Some states have chosen to move away from traditional subject areas such as math, science, history, and language arts preferring instead vague "interdisciplinary" expectations for students such as "human growth and development," or "cultural and creative endeavors."

Consequences for brain compatibility: The idea of core disciplines is limiting and totally ignores the educational implication of current brain research (Jensen 1998, Sylwester 1995).

Specific enough to assure the development of a common core curriculum

A good set of standards must outline the essential knowledge and skills *all* students need to learn in each of the subject areas. Standards defined in this manner guarantee that all students, regardless of background or neighborhood, are exposed to a common core of learning.

Consequences for brain compatibility: When students are unable to grasp "the essential knowledge and skills," they are often placed in remedial classes where basic skills acquisition is the focus. Such students are never given the opportunity to go beyond those basic skills and into the realm of problem solving and critical thinking. They can never see the "big picture" because all they get to view are the "tiny pieces."

Manageable given the constraints of time

Neither standards nor the resulting common core curriculum should try to cover everything to be taught. A core curriculum probably constitutes somewhere between one-half and three-quarters of the academic curriculum, the remainder being filled in by local districts, schools, and teachers.

Consequences for brain compatibility: A typical text book contains more than can be covered in a school year. As a result, teachers are forced to TEACH-TEST-MOVE ON, rather than check whether deep understanding has occurred. The AFT's concern with time constraints is in keeping with brain-compatible learning because without sufficient time to form connections, make information meaningful, and reflect upon what has been learned, what is taught is merely surface knowledge, soon to be forgotten.

Rigorous and world class

President Clinton signed *The Goals 2000: Educate America Act* in 1994, which established eight broad national education goals. One of the goals called for American students to be first in the world in math and science by the year 2000. States and professional associations that are setting standards often repeat the phrases "world class," "rigorous," and "challenging" to describe what they are doing. If standards truly are rigorous and world class, they need to reflect various levels of knowledge and skills comparable to what students in high-achieving countries are expected to master.

Consequences for brain compatibility: Brain-compatible learning is about the growth and development of a human being with a wonderfully unique brain. The standardized tests that claim to measure student performance relative to other students in this country or in others only measure what students *don't* know, not what they do. Therefore, an attempt to apply standards based upon a flawed method of evaluation is a flawed concept itself.

Include performance standards

According to the AFT in its document "Reaching High Standards: What it means and Why We Need It" (1997), when it members were polled, most agreed that all students are capable of doing better work and mastering more demanding material than what they are currently doing. Race car drivers are not simply told that "very fast driving" will qualify them for the big race. They know exactly what times they need to beat, and they plan their strategies accordingly. It should be the same for education standards.

Consequences for brain compatibility: The problem here is that "demanding" does not necessarily mean "better." The current drive for PERFORMANCE! ACHIEVEMENT! SUCCESS! comes at the expense of discovery, curiosity, and exploration, the very foundation of brain-compatible learning.

An inordinate emphasis on performance will only result in a situation where test scores are stressed at the expense of deep understanding and connections.

Include multiple performance levels

While high standards must be held for all students, not all students can be expected to meet the same standard. It would be unrealistic to expect the same performance level from everyone because some students simply are more able to master challenging material than are others. Using only a single standard might mean that either expectations would have to be set too low (low enough for most to pass, which does nothing to raise student achievement), or too high (too high for many to reach, which only discourages students from the idea of hard work). Instead, standards must be set so that they are within reach but still require dedication and hard work, a challenge that would encourage learners to seek their maximum potential.

Consequences for brain compatibility: On the surface, the above appears to be in harmony with brain-compatible learning. However, the way challenging is defined can prove to be either compatible with or contrary to the way the brain works. If "challenging" material feeds a student's intrinsic creativity and curiosity, then it is indeed brain-compatible and positive. If instead "challenging" means MEANER! HARDER! TOUGHER!, then it is extrinsically motivated and has negative implications for brain compatibility.

Combine knowledge and skills, not pursue one at the expense of the other

A false dichotomy exists within the current standards dialogue between knowledge and skills. Such a dichotomy is based on the concept that knowledge is dynamic, transient, and always changing, whereas the need to apply knowledge is constant. While this is true, it is the AFT's position that the important skills of problem-solving, decision-making, and higher-order thinking cannot be the end-all and be-all of curriculum. When skills are all that make up a state's standards, the resulting standards from that state lack subject matter such as the facts, ideas, concepts, and issues.

Consequences for brain compatibility: While the AFT's view may provide interesting food for thought, its obvious emphasis on the separation of knowledge and learning into discreet disciplines does not mesh with current learning research. Students need to "mess around" with problem-solving activities that do not have neat solutions. The knowledge of basic facts and skills is important at the primary and elementary level because that knowledge can be used as a tool to pique curiosity. Blind memorization of isolated bits and pieces of subject matter, by itself has no place in a brain-compatible curriculum.

Promise for the Future

New understandings are forming the basis for very different views of delivering, receiving, and using information and the resultant implications for teaching, learning, assessment, and existing organizational models. The emerging new paradigm is grounded in a sense of connection, wholeness, and the need for creating experiences that link learning to new and deeper understandings (Caine and Caine 1997). To assimilate the reality of an information-based society, educators must allow for a real change in the delivery of knowledge. Educators and others must be willing to become open to a basic paradigm shift in which meaningful knowledge and understanding is based on genuine insight and that requires students to construct understandings for themselves. Meaningful knowledge and understanding is revealed through the application and use of such knowledge in real-world situations. In other words, it is the *acquisition of meaningful knowledge* rather than the memorization of information from so-called experts that defines a true act of learning.

Student survey and graphing tasks allow students to gather and synthesize information. OPPORTUNITY FOR ASSESSMENT #3: *Television Time* provides students with the challenge of gathering data and constructing a visual representation of that data. There is no predetermined "correct" answer known only by the teacher, but instead the process of constructing meaning from data brings about a new an original result every time. While the processes may vary, the qualities (performance criteria) remain the same and are known before the work begins. The following performance task is suited to elementary students, but can easily be modified to fit the needs and standards of middle school and high school students. Middle school teachers may want to include a larger sampling and require that averages (means and medians) be calculated. A presentation element could also be added. Building on the middle level activities, secondary level students might be asked to discuss and reflect upon the concept of survey reliability. Perhaps the upper-level students could "publish" their finding on the school's Web site thereby allowing students an authentic audience for their authentic and original work.

Opportunity for Assessment #3

Television Time

Level Elementary

Content Standards

Mathematics

- ☐ Effectively uses a variety of strategies in the problem solving process
- ☐ Understands the general nature and uses of mathematics
- ☐ Understands and applies basic and advanced properties of the content of mathematics
- ☐ Understands and applies basic and advanced concepts of data analysis and distribution

Language Arts

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Writes with command of the grammatical and mechanical conventions of composition

Visual Arts

- ☐ Knows how to use the structures (e.g. sensory qualities, organizational principles, and expressive features) and functions of art.
- ☐ Understands the characteristics and merits of one's own artwork and the artwork of others

Performance Standards

- ☐ Accuracy of data
- ☐ Creativity of Graphic Design
- ☐ Understanding of graphical representation of data
- ☐ Neatness

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☑ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☑ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

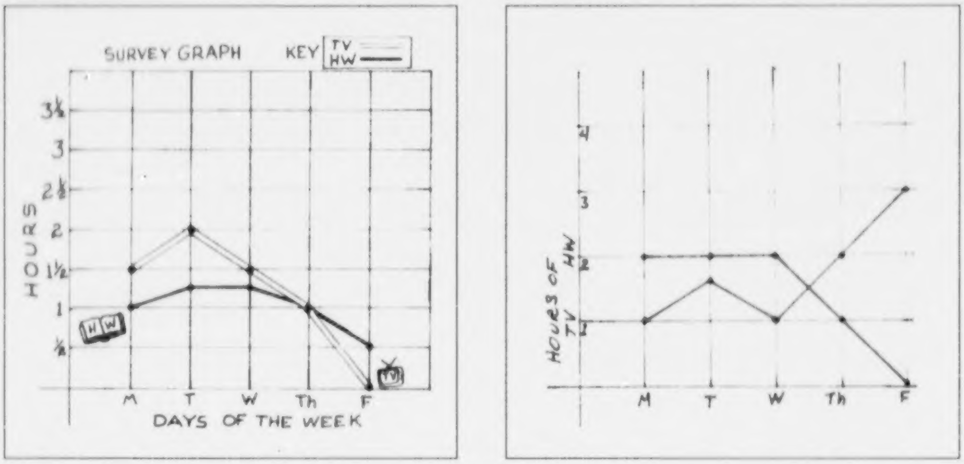
In pairs students graph the results of a class survey. The graph is to represent the number of hours students spend doing their homework versus the number of hours they spend watching television.

Assessment Technique: Scoring Rubric (Figure 1.6).

TELEVISION TIME ELEMENTARY SCORING RUBRIC				
Qualities Evaluated	**Advanced** ***Excellent and sophisticated work quality***	**Proficient** ***Accomplished level of work***	**Basic** ***Quality of work shows developing skill***	**Novice** ***Beginning-level work quality***
Accuracy of data	All computations are accurate	Accurate computation	Some inaccuracies	Inaccurate computation
Creativity of graphic design	Very unique and creative	Shows many elements of creativity	Shows some creativity	Shows no creativity
Understanding of graphical representation of data	Understands and synthesizes information	Understanding evident	Some understanding evidenced	No evidence of understanding
Neatness	Very neat and uniquely rendered	Well ordered and neat	Somewhat neat	Not carefully rendered

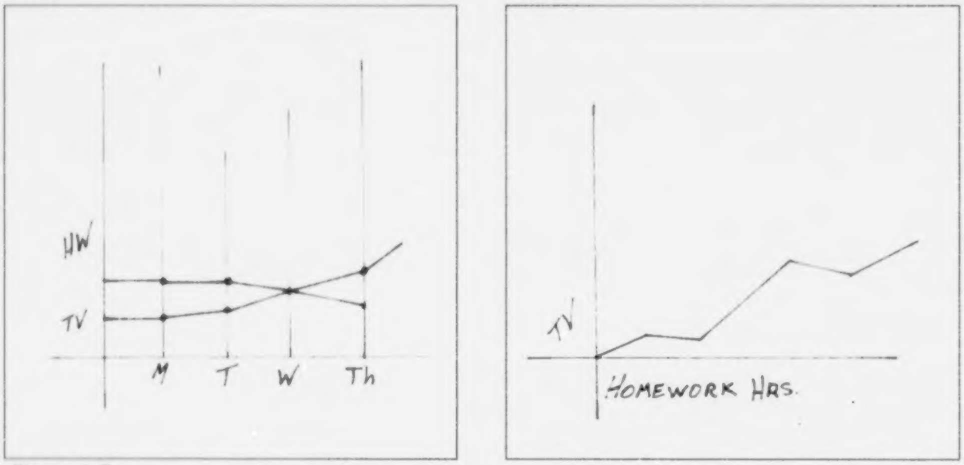
Figure 1.6

Student Samples (see Figure 1.7).



Advanced

Proficient



Basic

Novice

Figure 1.7

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CHAPTER 2

THE ASSESSMENT REVOLUTION

The simplest way to sum up the potential harm of our current tests is to say that we are not preparing students for real "messy" uses of knowledge in context (the "doing" of a "subject") because our testing is based on a simplistic stimulus/response view of learning.

—Grant Wiggins 1989, 202

The Need for Change

There is a growing recognition that in spite of a recent rise in standardized test scores, students are not necessarily becoming better educated or more knowledgeable. The discrepancy between traditional testing results and the reality of what high school graduates know and can or cannot do, provoked a disenchantment with traditional methods of assessing student learning, and has given impetus and momentum to the authentic assessment movement. An assessment focus that de-emphasizes traditional grades and demystifies the entire grading process is more in line with the manner in which the brain learns new information. Most advocates of authentic assessment don't want to totally eliminate traditional tests. What they seek is a good mix of assessment practices.

Cream of the Crop

Who is expected to learn? The central purpose for schooling has been reflected in this question. For years, education has sorted and selected students much like separating cream from milk. While the "cream" was destined for higher education, the "milk" became the workforce required to power the industrial economy. Consequently, policies, practices, programs, and procedures were developed in which all students were taught the same way (the teacher lecturing to passive students), given the same amount of time, and tested with assessments based on the bell-shaped curve. The system manufactured a large common labor force with workers identified by their failure to achieve.

A system whose main purpose is sorting and selecting is at odds with the concept of educating all students. Schools and districts must alter their purpose if the concept of education for all is to be adopted. Brain-compatible standards-based education introduces a different purpose, one that is focused specifically on sustained achievement for *all* students—regardless of gender, race, ethnicity, or socioeconomic status. Given appropriate time, multiple and varied instructional strategies, and clear goal expectations, many of the students previously considered underachievers (the "milk") can now meet or exceed rigorous academic standards.

The Standards Debate

The National Commission on Excellence in Education's now famous report *A Nation at Risk* sparked, or at least rekindled, the standards movement in America. Educational practices and policies had brought about what the report called "unilateral educational disarmament" (National Commission on Educational Excellence 1983, 5). In an attempt to "rearm" America's youth, a system driven by standards was sought. The Education Summit in 1989, called for and attended by then-present George Bush and the nation's governors, set the stage for the establishment of national standards. The National Council of Teachers of Mathematics (NCTM) soon developed a set of goals that were very well received. Other subject area organizations followed NCTM's lead and developed national standards of their own. The National Education Standards and Improvement Council (NESIC) was created in 1994 as part of the Goal 2000 legislation to "oversee and certify" standards created by the states (Kendall and Marzano 1999).

Soon however, the enthusiasm for standards waned. Content standards in some areas had sparked controversy while the sheer size and complexity of the standards produced was overwhelming. In addition, by 1995 the NESIC had effectively ceased to function. The standards movement was down but not out. The re-authorization of the Elementary and Secondary Education Act (now known as the Improving America's Schools Act [IASA]) in 1994 reinvigorated the standards dialogue by mandating the establishment of standards for schools receiving federal funds. By January 1998, 38 states had drafted academic standards in core subjects (English, math, science, and social studies) and thirty-four states used standards-based assessments of math and English. However, scholars engaged by the Thomas B. Fordham Foundation found that only one state had truly rigorous and clear standards in English, one in history, three in geography, three in math, and six states in science. A consistently rigorous level of standards in content area is a requirement if U.S. education is to step back from the precipice of risk. For educational reform based on standards to be successful, it must be consistent with brain-compatible instructional methodologies.

Writing and the ability to express one's self and explain one's environment are essential to literacy. Journal writing works with the processes of the brain and therefore stimulates understanding. The OPPORTUNITY FOR

ASSESSMENT #4 is presented as a stimulus for introspection and cross-content knowledge integration. While creative writing has traditionally been a part of language arts instruction, creativity and writing are valuable in promoting student understanding of other content areas. When journals are used in multi-disciplinary situations, they help build specialized vocabulary and a deeper understanding of underlying concepts. Students can keep a science fiction writing journal where the concepts experienced in the lab can be synthesized into an environment of the students' own making (a science fiction story). Or, students might engage in a historical diary project where they imagine themselves in the position of an historical figure, writing from that person's perspective. The *Creative Writing Journal* is appropriate for students of every level as long as the performance criteria are appropriately adapted. Even emergent readers and writers can take part with the assistance of a "scribe" or a voice-activated word-processing program or tape recorder.

Opportunity for Assessment #4

Creative Writing Journal

Level Secondary

Content Standards

Language Arts (descriptive and reflective writing)

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Writes with a command of the grammatical and mechanical conventions of composition
- ☐ Demonstrates competence in general skills and strategies of the reading process
- ☐ Demonstrates competence in speaking and listening as tools of learning
- ☐ Demonstrates an understanding of the nature and function of the English language

Performance Standards

- ☐ Effort
- ☐ Individual Progress

Multiple Intelligence Learning Styles

- ☐ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☐ Bodily/Kinesthetic
- ☐ Interpersonal/Social
- ☑ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Over the course of a semester, the student will maintain a personal creative writing journal in which they free write for a half hour everyday.

Assessment Technique Portfolio creation; the journal itself serves as the portfolio. Only novice (work is of poor quality) and Proficient (work is of satisfactory quality) are given because, in this instance, it is not what is being written that is being evaluated, but the fact that writing has taken place (see Figure 2.1).

JOURNAL ASSESSMENT RUBRIC

Qualities Evaluated	Proficient *Excellent and proficient work quality*	Novice *Beginning-level work quality*
Effort	Journal entries for most days. Substantial material presented in each entry.	No journal entries for most days. Length of entries is insubstantial.
Individual Progress	Progress evident from first entry to last.	No progress evident from first entry to last.

Figure 2.1

Forms of Assessment

The educational system is now presented with the challenge of developing appropriate and meaningful ways to evaluate the extent to which students are meeting the standards. Time honored methods, such as the standardized test, are being called into question. More progressive brain-compatible methods of measurement are gaining favor in light of scientific discoveries about how the brain processes information.

The Standardized Test

Horace Mann, the father of public education in the United States, was a firm believer in the concept of testing. As early as 1845, Mann was advocating the use of written tests to be comprised of a large numbers of questions with set answers as a way to evaluate student performance. Even then, early research in assessment and evaluation revealed problems with the objectivity of such evaluations. In further studies, it was discovered that when different teachers were given the same tests to grade, the scores varied widely and bore no relation to any uniform set of standards. In other early studies, papers that had received passing grades from evaluators the first time, were graded as failures when given to the same evaluators a second time, with the reverse situation occurring with as much frequency (Hart 1994).

The results brought attention to the need for greater objectivity in assessment. In fact, it was the perceived need for objectivity that first gave rise to the scientific testing movement early in the twentieth century. The direct result of the movement was the development of the *standardized test,* a mass-produced, multiple-choice test that could be administered to large numbers of persons with consistent results. To ensure the accuracy of the tests, statistical concepts and techniques were designed and developed to eliminate problems like subjectivity in scoring. By 1928, there were over a thousand standardized tests available in the U.S., each with a statistically calculated measure of the test's *validity* (how well it measures what it is supposed to measure) and *reliability* (how consistently the scoring results will be over time and in different testing situations). The development of the standardized test led to the rise of the testing industry whose market expanded in the 1920s with the onset of official state testing. After World War II, two main trends contributed to the further expansion of the test industry, the decline of the one-room school house and accountability. By 1950, the one-room schoolhouse had evolved into a new model of instruction, one based on the factory design with its concept of mass production. The secret to making this factory-like school work was to break the learning down into small skills and bits of knowledge that could be taught and learned sequentially as the students moved along the educational assembly line. Standardized tests fit nicely into this model of instruction. With their multiple-choice formats, standardized tests made the perfect tool for measuring the mastery of sub-skills, or bits of content, for large numbers of students. With the advent of computerized scoring, standardized tests became even cheaper and easier to use.

The second trend that encouraged the growth of the test industry was the increasing concern over accountability. During the post-war years, Baby Boomers swelled school populations, and the amount of money that was spent on education increased precipitously. Unfortunately, student achievement did not keep pace with the educational investment. By the 1970s, Scholastic Aptitude Test (SAT) scores began falling while employers started complaining that high school graduates were neither able to read nor write. Angry taxpayers, not quite sure of where to place the blame for the failure, sought solutions by measuring and monitoring what went on in the schools. As a result, the standardized test became the assessment tool of choice for monitoring school quality.

By the 1980s, educators had begun to realize that the standardized test was fast becoming the driving force behind the curriculum. The consensus among many educators was that to move education away from its emphasis on memorization of isolated facts, education would need to move in a direction of increased emphasis on higher cognitive thinking skills. For such a change to take place, assessment methods needed to evolve and be redesigned into something other than the machine-scored multiple-choice test.

TECHNICALLY SPEAKING

Most standardized tests fall into two categories: norm-referenced and criterion-referenced tests. Both test types rely heavily on the multiple-choice format. *Norm-referenced* standardized test scores give numbers that reflect achievement and performance of isolated skills at a particular moment in time. The norm-referenced testing is designed as a means of ascertaining an individual's performance in relation to the performance of other individuals on the same test. The scores are plotted along some form of the normal distribution curve. Such a test is designed to show how a given student or group of students rank when compared with other test takers of the same age and grade. With this method of evaluation, a certain percentage of the tested population *must fail* to establish the *norm* against which all the other students are measured. In a standardized test, the norm (or standard of performance) is determined by recording the scores of a large group, such as a sample of elementary school students. When subsequent students take the test, the norms for them will be those of the larger group (the group on which the test was "standardized"). Figure 2.2 shows a normal distribution curve. Test items are selected based on their ability to make distinctions among students. Items on which most students score either very high or very low are not retained for future tests because they do not discriminate among students. Consequently, some content standards may not be measured.

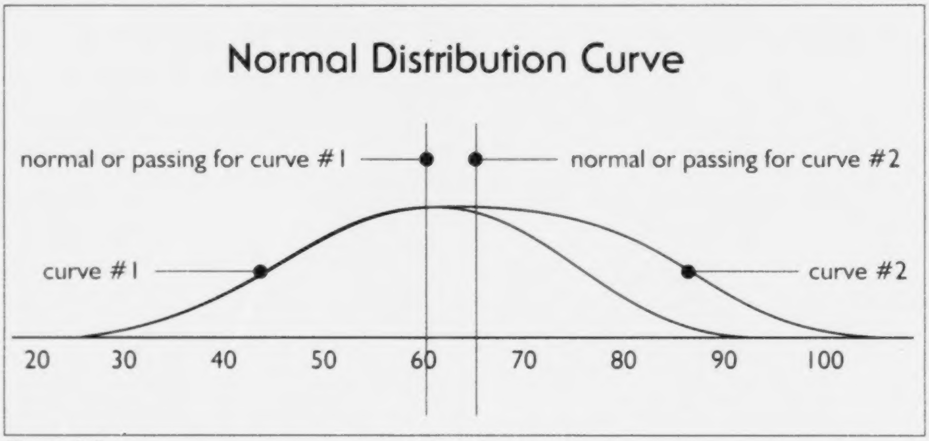

Figure 2.2

A *criterion-referenced* test, on the other hand, is a way to measure an individual's performance against established criteria or expected standards (what a student should know at a given point in his or her education). The goal is to help all students attain at least the minimum level of mastery. Items chosen for inclusion on such tests are intended to reveal a student's strengths and weaknesses in terms of knowledge or skills. Competency tests and achievement tests are types of criterion-referenced tests. The criterion-referenced approach specifically provides for the following:

1. Test takers know what level of performance is expected of them in advance; therefore, students know what they must do to be successful on assignments and tests.
2. Teacher's subjective judgement is limited because the test content is not decided by a single individual.
3. Students are not fighting against each other for a place on the distribution curve; consequently, a noncompetitive environment results.

The problem with criterion-referenced tests from a brain-compatibility perspective is that the items chosen may be measuring only superficial knowledge, involving memorization and mechanics rather than higher order thinking skills. In addition, because the evaluation occurs in an environment foreign to the subjects' context, is stressful, and occurs only once, it cannot give an accurate portrayal of an individual's knowledge.

Critics point out that standardized tests corrupt the very process they seek to improve. America's reliance upon tests, they contend, has damaged teaching and learning by putting too much value on memorization of isolated bits of information at the expense of higher thinking skills. Teachers often feel the pressure to focus more on what can be easily tested than on what is important for students to learn. Students are thereby conditioned to be passive learners who can only recognize information rather than construct their own answers and solutions.

In addition, standardized testing neglects the vital aspect of emotion in assessment. (For a discussion of the role emotion plays in the learning process, see the "Emotion in Context" section of chapter 1.) If a student typically learns in a classroom and then is tested in a media center or an auditorium, that student is more likely to underperform. Similarly, if a student learns in a particular emotional state, he or she will most readily recall that learning when in that same state. It is the job of the assessor to match the memory mechanism at assessment time to that which occurred during learning, or the student may not be as successful as he or she might be in demonstrating the knowledge learned. The best way to do such an evaluation is by providing opportunities for assessment that occur as part of the learning process.

Observation and conferencing strategies work very well for tasks that have some kinesthetic or performance element to them where progress toward a goal can be monitored in addition to assessing the final product. OPPORTUNITY FOR ASSESSMENT #5 has students acting out a kind of interplanetary play. *Planets in Motion* offers a performance task appropriate to the elementary level. (Pre K students may also be able to learn from and enjoy this activity.) In addition, middle level students can perform the task with a higher degree of accuracy and "reality" by plotting the respective planets' orbits and scaling them down to fit on the playground. They may also be asked to reflect upon the role size plays in the gravitational pull of an object and why planets travel in elliptical orbits. Secondary level students may act out more complex processes or re-create famous experiments "live" in front of an audience. These performances can be videotaped and used by students to critique their individual performances or the tapes can stand as example for future classes of what "excellence" looks like. Activities in which students play a particular role in a complex process must allow time for students to see their role as part of a bigger picture, otherwise learning may be fragmented. Witnessing their performance on videotape or seeing their place on a diagram of their creation will help them bring their experiences into the larger context.

Opportunity for Assessment #5

Planets in Motion

Level Elementary

Content Standards

Science

- ☐ Understands basic features of the planet Earth
- ☐ Understands basic Earth processes
- ☐ Understands essential ideas about the composition and structure of the universe and Earth's place in it

Language Arts

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Demonstrates competence in the general skills and strategies of the reading process
- ☐ Demonstrates competence in the in the general skills and strategies for reading literature

Physical Education

- ☐ Uses a variety of basic and advanced movement forms
- ☐ Uses movement concepts and principles in the development of motor skills

Performance Standards

- ☐ Organization and clarity of thought
- ☐ Writing mechanics of punctuation, grammar, and spelling
- ☐ Creativity and originality of content

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

In a large area such as a playground, students will take turns placing themselves in different locations as they act out the rotation of the planets and their orbits. Once back in the classroom, students will write a paragraph about the planetary relationships.

Assessment Technique

Performance assessment (informal observation). Observation is an important means of assessment integration. With observation, the teacher is able to monitor the learning process as it occurs within the group (see Figures 2.3 and 2.4).

OBSERVATION RUBRIC	
Focus Items	**Observations**
Concepts: planet placement in the solar system	Jimmy has difficulty locating Earth's position relative to the sun. Beth (as the sun) explained to Jimmy why he had to move around her.
Techniques: verbal interaction of students with teacher guidance	Some students are having difficulty with individual planet's orbits and rotation speeds. Design an activity that will help focus them on this concept.
Problem-solving/reasoning	Some of the students are able to explain the logic of the solar system to the others. We need to go over the basic planet relationships in class again.
Communication and collaboration	Beth and Tom are very helpful with the other students, always trying to help them see where they might fit into the orbit design. Jimmy, as Earth, is set on being the center even though he knows his science facts.

Figure 2.3

PARAGRAPH ASSESSMENT RUBRIC				
Qualities Evaluated	**Advanced** ***Excellent and sophisticated work quality***	**Proficient** ***Accomplished level of work***	**Basic** ***Quality of work shows developing skill***	**Novice** ***Beginning-level work quality***
Organization and clarity of thought	Work is highly organized and shows planning	Organized and thoughtful; clearly stated	Some organization and clarity of thought	Lacks evidence of organization or clarity of thought
Writing mechanics of punctuation, grammar, and spelling	No mistakes of punctuation, grammar, or spelling	Mistakes in punctuation, grammar, and spelling do not detract from the expression	Some knowledge of punctuation, grammar, and spelling is evident	Poor writing mechanics (punctuation, grammar, spelling)
Creativity and originality of content	Ample evidence of creativity and originality of content	Evidence of creativity and originality of content	Some attempt at creativity in content	Little or no creativity or originality of content

Figure 2.4

Student Samples (see Figure 2.5).

Advanced
For our science period, we went to the playground and pretended to be the planets in our solar system. Mr. Blank told us to try and rotate in our own orbits as if we were the real planets moving around the sun.

Proficient
Today we played that we were the planets turning around the sun. We were turning in paths called orbits.

Basic
We went to the playgrond today and made beleave we were the planits. I wanted to be the second planet venis.

Novice
We play planet in yard. I play mercry. I go to sun.

Figure 2.5

Alternative Assessments

Alternative assessments are any and all assessments other than the standardized test-type assessments. A broad definition of alternative assessment includes any type of assessment in which a student creates a response to a question rather than choosing a response from a given list (as with multiple-choice, true/false, or matching). Some of the different alternative assessments include short answer questions, essays, products, performances, oral presentations, demonstrations, exhibitions, and portfolios.

Standards found in the National Council of Teachers of Mathematics Standards (NCTM, 1989, 1991,1995), and the National Science Education Standards (NSES, 1995) present a vision of assessment that is highly brain-compatible in that it is ongoing and carried out in multiple ways. By listening to, observing, and talking with students, by asking students questions to help reveal their reasoning, by examining students' individual or group written and/or problem solving work, teachers are able to develop a more accurate and valid picture of what students know and can do.

When conceived of and used in such a non-threatening, brain-compatible manner, assessment provides teachers with the best way to gain valid insights into their students' thinking and reasoning abilities. Consequently, assessment becomes a powerful tool to help teachers monitor the effectiveness of their own teaching, judge the utility of the learning tasks, and consider when and where to go next in instruction. The focus is on high but achievable targets for students to meet rather than comparing student performance to the performance of other students. When information is shared with the students regarding precisely what they are expected to know and be able to do, students are able to meet or even exceed the standards.

Informal Assessments

To evaluate the intangible processes taking place in the classroom, especially during group activities, teachers must perform observations. *Observations* consist of information gathered by teachers mainly in their day-to-day classroom encounters with students that registers students' internal processing of information, student to student interaction, and the discussion and revision of ideas. Assessment should be embedded in instruction, or in other words, integrated within the instruction. Observation is particularly important as a means of bringing about such integration of instruction and assessment. Through group as well as individual student observations, teachers are able to develop a sophisticated and complex picture of student learning. By using an observation time frame of ten to fifteen minutes, teachers can acquire the optimal perspective on group processes regarding topic content, social dynamics, or needed help. The Observation Rubric (see Figure 2.3) provides a sample of how teachers might officially record their assessment observations in an orderly and relatively objective manner. It is a good method for the organization of observations and helps to connect students to the learning content.

Another informal assessment method is to conduct active meetings with students either individually or in small groups. Such meetings, or conferences, can be brief (three to five minutes) or longer if needed. It is often beneficial to give a particular student or group a specific assignment, such as exploring a problem, asking a peer for an explanation, or researching a similar topic in order to provide a focus for student work. In this way, the next

STANDARDIZED TESTS vs. BRAIN-COMPATIBLE ASSESSMENT

Standardized Testing	*Brain Compatible Assessment*
• results based on a mythical standard or norm, which requires that a certain percentage of children fail	• establishes an environment where each child has the opportunity to succeed
• pressures teachers to narrow their curriculum so that they can specifically concentrate on the test material	• allows teachers to develop meaningful curricula and assess within the context of that program
• emphasizes a single instance assessment, which has no relation to the learning taking place in the classroom	• assessment is on going throughout the unit of study, and provides an accurate picture of student achievement
• focuses on errors and mistakes rather than what has been accomplished	• puts the emphasis on student strengths rather than weaknesses
• focuses too much importance on single sets of data (i.e. test scores) in making educational decisions	• provides multiple sources of evaluation that give an in-depth view of student progress
• treats all students in a uniform way	• treats each student as a unique human being
• discriminates against some students because of cultural background and learning style	• provides the opportunity to eliminate cultural bias and gives everyone an equal chance to succeed
• regards instruction and assessment as separate activities	• regards instruction and assessment as being a single, integrated activity
• answers are final, there is no opportunity for reflection or revision	• engages the student in a continual process of self-reflection, learning, and feedback, as well as revision
• focuses on the "right" answer without regard for understanding	• deals with comprehension and the learning process as much as the final product
• inexpensive and easy to administer and grade	• more difficult to achieve consistent, objective scoring results
• often provides results that can be simplified to a single numerical score	• data cannot easily be simplified as a single number
• easy to compare and contrast different populations of students	• difficult to compare different student populations

Figure 2.6

conference or observation held with that particular group or individual will provide the teacher with a good indication of the progress made by the group or individual. Focused, informal assessments help teachers keep up with students' varied progress rate and needs, which is especially important with more extensive projects.

Authentic Assessment

One of the major forms of alternative assessment is the *authentic assessment*. An assessment is considered to be "authentic" when it involves students in tasks that are worthwhile, significant, and meaningful (tasks that take into account that the search for meaning is innate in all humans); occurs over time (not just one day); is open-ended; and allows for students to demonstrate competence in a variety of ways. Such assessments involve higher order thinking skills along with the use of a broad range of knowledge. In addition, authentic assessment demonstrates to the student exactly what it means to do excellent work by making explicit the standards by which that work will be evaluated. In this sense, authentic assessments are *standard-setting* assessment tools rather than *standardized assessment* tools.

To be brain-compatible, authentic assessments are defined /comprised of the following:

Structure

- involve an audience, more public than traditional forms of assessment
- do not rely on arbitrary or unrealistic time constraints
- contain questions or tasks that are known beforehand and are not "secret"
- encompass multiple opportunities for demonstration of growth (i.e. portfolios) rather than one-time, stressful experiences
- include some sort of collaboration with peers
- allow for a significant degree of student choice

Intellectual Design Features

- directs students toward more sophisticated uses of knowledge and skills (i.e. critical-thinking skills)
- integrates tasks and their outcomes
- assesses thinking processes rather than bits and pieces of isolated information
- may involve somewhat ambiguous or "messy" tasks and/or problems to be solved
- utilizes the student's own research or use of knowledge
- presents a challenge that emphasizes depth of knowledge and understanding
- stimulates and educates so that students can learn from the assessment process

Grading and Scoring Standards

- based on clearly articulated criteria and performance standards rather than a curve or norm
- uses performance indicators, which allow students to know ahead of time what excellence looks like
- makes metacognitive activities such as self-assessment and self-reflection part of the total assessment process
- uses a multi-faceted scoring system rather than a single numerical grade

Equity

- identifies hidden strengths rather than weaknesses
- de-emphasizes competitive comparisons between students
- allows for different learning styles, abilities and interests

Authentic assessments are brain-compatible. When correctly designed, they emphasize learning and thinking, especially those higher-order thinking skills involved in problem solving. Authentic assessments are comprised of meaningful tasks that reflect real-life, interdisciplinary challenges; they present students with complex, ambiguous, open-ended problems and tasks that integrate their knowledge and skills. Such assessments usually culminate in student products or performances that recognize and value each student's multiple abilities, varied learning styles, and individual background. Calculators and dictionaries are necessary tools in the real world. If the job of educators is to prepare students to function in the real-world, then students should be taught when and how to use real world tools. Therefore, calculators, dictionaries, relevant textbooks, and other materials should be made available to students during an evaluation if the evaluation is genuinely authentic.

A Starting Point

The results of standardized norm-referenced tests have become the virtual standards by which American public education is judged. Standardized testing has its place, but is ultimately a poor judge of a school's quality of instruction. Relevant and meaningful standards in conjunction with authentic assessments would provide a real means of evaluation. Any attempt to change the status quo, however, would first require that the validity of a new assessment strategy be quantified. A starting point for such would be the comparison of the performance of the same group of students on both the norm-referenced test and the replacement measure. Standards-based or criterion-referenced assessments can be cross-referenced to standardized norm-referenced tests by conducting a concurrent validity study (Burger & Burger 1993). In such a study, students would complete both a standardized norm-referenced test and a criterion- or standards-based test measuring a similar domain, reading for example. Statistical analysis could then provide both correlated data and the relationship of performance standards to percentile scores. The linkage between the two assessments would assure that the new assessments are rigorous and that the performance standards are worthy. There's no one best assessment method. The choice of using multiple-choice tests, performances, projects, exhibitions, or portfolios depends on what's being assessed, the purpose for the assessment, as well as how the assessment results will be used. A combination and variety of assessment formats is what is needed for a thorough and complete picture of student progress and growth.

A project that takes a number of weeks to complete will, in theory, allow for greater student thought about the process and what they want their product to look like. Portfolio-type performance tasks, such as the one presented in OPPORTUNITY FOR ASSESSMENT # 6: *Campaign Scrapbook,* allows students to choose the way in which they will depict an idea or concept. When left to choose, students will often pick depictions and activities that are best suited to their most pronounced learning styles. The end result of a campaign scrapbook will look different for each student, but the criteria upon which it is evaluated will remain the same. The organizational structure, for instance, may vary widely but some organizational planning should be evident in the product. The scrapbook concept can be adapted to suit additional content areas and levels. Elementary students can create a scrapbook of food labels and remark upon the use of color, wording, and logos to introduce or reinforce the concept of the symbolic use of language. Secondary students might keep the campaign element of the scrapbook but include editorials along with campaign ads to compare and contrast the approaches, the purpose, and the relative effectiveness of each. Student can then reflect upon the concept of rhetoric and debate. An extension of the task at all levels can include students creating their own advertisements (or product labels).

Opportunity for Assessment #6

Campaign Scrapbook

Level Middle

Content Standards

Social Studies (civics)

- ☐ Understands the character of American political and social conflict and the factors that tend to lower its intensity
- ☐ Understands basic concepts about civic life, politics, and government

Language Arts

- ☐ Demonstrates competence in the general skill and strategies of the writing process
- ☐ Writes with a command of the grammatical and mechanical conventions of composition
- ☐ Demonstrates competence in general skills and strategies of the reading process
- ☐ Demonstrates competence in speaking and listening as tools of learning
- ☐ Demonstrates an understanding of the nature and function of the English language

Performance Standards

- ☐ Organization
- ☐ Communication (mechanics and ideas)
- ☐ Comprehension (insights and connections)
- ☐ Variety
- ☐ Presentation
- ☐ Reflection

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☐ Bodily/Kinesthetic
- ☐ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Students will maintain a scrapbook of campaign advertisements from a variety of different candidates and chronicle alongside the ads their observations and reflections on those advertisements.

Assessment Technique

Portfolio Assessment is perhaps the best method to show a student's processing and reflection (see Figure 2.7).

CAMPAIGN SCRAPBOOK EVALUATION RUBRIC				
Qualities Evaluated	**Advanced** ***Excellent and sophisticated work quality***	**Proficient** ***Accomplished level of work***	**Basic** ***Quality of work shows developing skill***	**Novice** ***Beginning-level work quality***
Organization	Superior organization and planning readily apparent	Organized	Somewhat organized	Disorganized
Communication (mechanics and ideas)	Clearly communicates ideas	Most ideas immediately understandable	Few ideas communicated clearly	Ideas not communicated clearly
Comprehension (insights and connections)	Shows exceptional insight and understanding	Show some degree of connection	Shows little understanding	Shows no understanding
Variety	Uses a wide variety of ads from national, state, and local races	Some variety in ad choice	A small number of advertisements are included	No variety, or no advertisements at all
Presentation	Uniquely presented, exciting to look at	Attractive, attention-getting presentation	Some effort put into presentation	Little effort put into presentation
Reflection	Evidence of thorough, realistic, and constructive reflection	Evidence of some constructive thought processes	Lacks evidence of constructive thought processes	No evidence of reflective thought processes

Figure 2.7

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CHAPTER 3

ASSESSMENT FORMATS

STANDARDS, DESIGN, AND BRAIN-COMPATIBLE LEARNING

[T]he significance of classroom assessment extends beyond the role of measuring learning. What we assess, how we assess and evaluate, and how we communicate results sends a clear message to students about what is worth learning, how it should be learned, what elements of quality are most important, and how well we expect them to perform.

—Jay McTighe and Steven Ferrara 1996

On the Lookout for Success

Evaluation is more then a single event. It is, instead, a complex process that shapes what one looks for in, and what can be said about student performance. Typical tests, even challenging ones, tend to over-assess student knowledge and under-assess the application of that knowledge and true intellectual performance. Synthesis of knowledge, an ability that is rarely tested, cannot be assessed using multiple-choice tests since the demonstration of such synthesis requires the production of an original response that is unique to each student.

From a brain-compatible perspective, assessment is viewed as an ongoing activity in which teachers gather information about student learning in multiple ways: by listening, observing, talking with students, posing questions, and examining written student work. Such means of assessment must be organized so that they can produce a coherent story of student progress, help students make more progress with greater focus, and complement other types of assessments. Helping students learn and grow becomes easier when day-to-day assessment is well integrated within the instruction process.

Performance Assessments

Performance assessments are brain-compatible because they help learners make the connection between their instruction and the manner of assessment. Such arrangements also encourage intrinsic motivation, self-reflection, and responsibility on the part of the learner. Because the learners have been carefully taught the criteria upon which their performance will be evaluated, and therefore know what will be expected of them, the assessment is not a highly stressful experience.

Performance assessments are comprised of essentially two parts: the performance tasks and the performance criteria. Because different tasks require different sets of criteria, the task is designed first, employing the technique of "backward planning" (Wiggins 1989 and McTighe 1994).

Timelines are a good way to assess student understanding of a broad concept and to see how the various "little pictures" that make up the big one. The OPPORTUNITY FOR ASSESSMENT # 7 challenges secondary level students to construct a timeline showing the course of America's westward expansion. It requires an understanding of the many and various circumstances that propelled manifest destiny and requires that those occurances be put into their proper context (their sequential places on a timeline continuum). Finding something's place in context is distinctly brain compatible and thus aids in student understanding and meaning making. Because paragraphs from textbooks must be distilled to their essence for inclusion on the chart, students must make choices about what events to include and be prepared to defend those choices. Different student teams may wish to depict westward expansion from different points of view (from a legislative perspective, a settler's perspective, a native American perspective). Each depiction is unique and valid as long as the performance criteria and student reasoning are maintained. Timelines are visual representations that provide an adhesive quality to the work for students. Middle level student performance tasks may not vary too widely from their secondary counterparts but should be tied to the appropriate content and performance standards. An elementary level timeline project might have students create a timeline of their own lives that contains their past, present, and predicted future. Artifacts from their lives (photographs, souvenirs, report cards, or a lock of hair) can be affixed to the timeline to for illustration.

Opportunity for Assessment #7

Westward Expansion Timeline

Level Secondary

Content Standards

Social Studies (U.S. history)

☐ Analyzes chronological relationships and patterns
☐ Understands the historical perspective

Language Arts

☐ Demonstrates competence in the general skills and strategies of the writing process
☐ Demonstrates competence in the general skills and strategies of the reading process
☐ Demonstrates competence in the general skills and strategies for reading literature

Visual Arts

☐ Uses the structures (e.g. sensory qualities, organizational principles, expressive features) and functions of art

Performance Standards

☐ Organization
☐ Variety
☐ Communication
☐ Historical perspective
☐ Creativity and originality
☐ Teamwork

Multiple Intelligence Learning Styles

☑ Visual/Spatial
☐ Logical/Mathematical
☑ Verbal/Linguistic
☐ Musical/Rhythmic
☑ Bodily/Kinesthetic
☑ Interpersonal/Social
☐ Intrapersonal/Introspective
☐ Naturalist

Performance Task

Working in pairs, students will create a timeline with corresponding graphics representing the chronology of the westward expansion of the United States.

Assessment Technique

Portfolio Creation—shows student progress over time; allows for extended product revision and development; a means for ongoing feedback between students and teacher (see Figure 3.1).

PORTFOLIO EVALUATION RUBRIC				
Qualities Evaluated	**Advanced** ***Excellent and sophisticated work quality***	**Proficient** ***Accomplished level of work***	**Basic** ***Quality of work shows developing skill***	**Novice** ***Beginning-level work quality***
Content	All dates are correctly and sequentially presented	Dates are sequentially presented	Some information presented out of sequence	Incorrect dates or information presented out of sequence
Organization	Very logical layout, making the finished product easy to understand	Logic evident in the layout	Some degree of logic evident in the layout	No logical layout making the finished product difficult to understand
Variety	Wide variety used	Apparent	Some	None
Communication	Very clear and concise	Successful for the most part	Effective communication attempt	Poor
Historical perspective	Ample evidence of understanding	Evidence of understanding	Some evidence of understanding	No evidence of understanding
Creativity and originality	Demonstrates uniqueness, innovation, and is visually pleasing	Demonstrates innovation	Some	Little or none
Teamwork	The finished product contains numerous contributions from each of the team members	The finished product contains contributions from all of the team members	The finished product contains contributions from most of the team members	The finished product does not contain equitable contributions from each team member

Figure 3.1

The Performance Task

Performance tasks are the activities that students undertake (a performance, presentation, panel discussion, etc.) to demonstrate what they know and can do. Performance criteria are applied to those tasks for purposes of evaluation. For example, the creation of a graph is a task that provides the student with the opportunity to demonstrate accuracy, graphic representation, and organization. Which, in turn, provides the teacher with the opportunity to judge the quality of the performance (the completed graph) by how well the student demonstrated his or her mastery of the criteria (in this case: accuracy, graphic

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representation, and organization.) Both high quality tasks and high quality performance criteria are essential for the design of a good performance task assessment.

Performance samples, the tangible products that serve as evidence of student achievement, can be created as an open-ended task, an extended task, or during portfolio creation. The *open-ended task* presents students with situations that encourage those of differing abilities and backgrounds to approach tasks in different ways, and to follow multiple paths in the framing of their responses. The *extended task* is a long-term, multiple-goal project that might be assigned at the beginning of a term or unit of study. Such long-term projects often serve as the focal point for a unit of study. They create a real-world context for the learning and assessment by connecting content to a challenging and interesting task. *Portfolio creation*, a concept borrowed from artists and designers, has generated the most interest among authentic assessment enthusiasts and is discussed in detail below.

Portfolios

Portfolios are one of the most comprehensive means of evaluating learner growth and progress. A portfolio is an organized, purposeful collection of documents, artifacts (student work that goes into the portfolio), records of achievement (comments and observations by the teacher), and reflections (the student's personal thoughts on his or her own learning [metacognition]).

TYPES AND USES OF THE PORTFOLIO

Among the variety of portfolio systems in use, three main types lend themselves most readily to education: the working portfolio, the showcase portfolio, and the assessment portfolio. The *working portfolio* is used to demonstrate a learner's growth over a period of time. It contains student works-in-progress as well as completed pieces. It is also where work can be stored until it is moved to either a showcase or assessment portfolio. The working portfolio is evaluated only periodically (if at all) to provide students with feedback, not a grade.

The *showcase*, or display portfolio (like those used by artists and other professionals) is used to demonstrate the highest level of achievement attained by an individual. Since it is a compilation of the learner's best work, it is also the portfolio method that best contributes to an individual's self esteem.

The primary purpose of the third kind of portfolio, the *assessment portfolio,* is to document student learning regarding specific curriculum objectives. Items contained in this kind of portfolio are designed to demonstrate the learner's achievement of certain curriculum objectives.

RATIONALE FOR USE

Portfolios are not merely means for grading students, but rather, a means of assessing learning. Report cards usually provide only a single indication of performance, such as a letter or number grade. Portfolios, on the other hand, have the capability of providing a rich variety of performance descriptions.

The following profiles the benefits of portfolios:

Portfolios...

1. Allow students to demonstrate significant learning through a finished product.
2. Provide parents with an opportunity to see and value students' progress.
3. Empower the teacher to become more knowledgeable about each student's strengths and weaknesses.
4. Encourage better one-on-one communication between the student and the teacher.
5. Enable the teacher to develop a more complete picture of each individual student to identify potential learning gaps before the end of a unit.
6. Promote both student and teacher awareness. (Students develop an awareness of their own learning styles and preferences while teachers are better able to assess the needs and wants of each student.)
7. Encourage the development of higher-order thinking strategies such as analysis, synthesis, and evaluation.
8. Value process as well as products.

DEVELOPING A PORTFOLIO SYSTEM

In view of the fact that portfolio entries represent a kind of performance, the steps involved in the development of an assessment portfolio system resemble the principles for developing good performance assessments.

1. Curricular objectives are determined.
2. Purpose (i.e. placement in an advanced class) is stated.
3. Performance tasks are outlined for the curricular objectives (encompassing both content and performance standards) to ensure that the tasks match the purpose or objectives of the instruction.
4. Criteria for each performance task are determined and performance standards for each criterion are established. ("Backward planning.")
5. Rubric is designed.
6. Evaluators are identified and trained to score the assessments (thereby the enhancing reliability of the assessments).

Items placed in the portfolio must demonstrate and document what the students have learned. Assessment portfolios allow students to show aspects of their learning such as growth and progress, creativity and originality, and introspection, which are not well-profiled in traditional assessments.

Developing the portfolio as an assessment tool requires careful planning and effort. A well-designed portfolio has the following characteristics:

It is…

Multi-sourced—a portfolio consists of numerous and varied components that can come in different forms (audiotapes, conference notes, photographs, computer disks, and artwork to name some).

Authentic—the pieces included must be relevant and worthwhile.

Dynamic—a portfolio shows learning "in progress," the sequential development of a student's growth. The portfolio contains student-selected work taken from different aspects of that student's learning progress.

Explicit in purpose—the student must have a thorough understanding of the learning activity's purpose and a clear comprehension of the evaluation criteria and teacher expectations before any work is begun. This allows the student to better focus on what he or she is doing well and what needs improvement.

Well integrated—the student's work must have relevancy to the real world and his or her daily experiences. Skills should be taught and learned in context, addressing the "why" as well as "how" of the learning.

Student owned—the student learns to take responsibility for his or her own learning. Ultimately it is the student who chooses the work which will become portfolio evidences and who is responsible for the feelings and information contained in the reflective self-evaluations.

Multi-purpose—a portfolio can provide a link across grade levels and subjects when shared with other teachers.

In addition, a description statement is attached to each portfolio entry and specifies what the piece is, its purpose, and of what learning it evidences. The purpose of this descriptive statement is to help the student articulate his or her thoughts by providing a clear rationale for the inclusion of each item.

For a portfolio *system* itself to be successful, it must include five essential components:

1. Student Access: The students must always have free access to their portfolios. One of the goals of portfolio evaluation is that the students take responsibility of their own assessment, and without access, this cannot be achieved.
2. Student Ownership: Students must feel that they are in charge of their portfolio, not the teacher. It is up to the students to choose the items to be included as well as the method for the portfolio's organization.
3. Relevant Items: The work kept in the portfolio must be relevant to what the students have been doing in class and how they have grown as a result of that doing. Items included should demonstrate the kinds of changes the new learning has brought about.
4. Organization: With a portfolio collection as with any collection, there must be some kind of logical order and organization. A good organizational outline should include a student's statement about the portfolio's purpose and some means of tracking the contents (an entry log or table of contents).
5. Sharing: Students need the opportunity to share their work and their progress. Sharing makes students verbalize their reflections. In addition, the feedback provided from those with whom the material is shared allows for students to experience constructive criticism.

While the temptation is to focus primarily on the product (the portfolio), the development process is just as important because it integrates instruction and assessment. Figure 3.2 provides an overview of the Portfolio Assessment Process.

SUMMARY OF THE PORTFOLIO ASSESSMENT PROCESS

Definition of Student Portfolios

- Systematic collection by students and teacher of multi-sourced student work
- Can be used to assess and evaluate student effort, improvement, learning processes, and achievement

Rationale for Portfolio Evaluation

- To provide a tangible record of a learner's development, growth, and progress or a concrete display of a learner's best work
- To provide a tangible display of the range of learning experiences and activities
- To encourage both student and teacher metacognitive thought through written reflection on learning goals, attitudes, knowledge, and strategies

Portfolio Contents

- Statement of purpose for portfolio
- Table of contents (compiled when prepared for presentation)
- Products or artifacts (student samples, tapes, photographs, copies of events or products, checklists, questionnaires, etc.)
- Written captions for each entry (description or explanation of each product or entry explaining the significance of each)

Advantages of Portfolios over Tests

- Emphasis on both process and product
- Student involvement and ownership
- Open-ended and flexible, emphasizing the uniqueness of each learner
- Emphasis on goal setting and self-evaluation
- Rich and varied data on student growth taken at different developmental stages
- Supports self-assessment, goal-setting, and independent learning
- Portfolio components provide more concrete and relevant evidence of student growth than traditional assessments

How do Portfolios Support Independent Learning?

- Can be used to showcase student's best work
- Encourage students to become actively involved in setting their own goals and objectives, as well as choosing which contents to showcase
- Reflections encourage metacognitive growth as well as higher cognitive levels of thinking such as analysis, synthesis, application, and evaluation

Figure 3.2

Implementation Strategies

At times it may be necessary for the teachers to help students develop skills they will need to achieve a quality portfolio. The following are a sampling of possible implementation strategies teachers can use:

1. Provide a time and place for students to talk and write about their reactions to the new assessment process. Peer review of portfolio experience can be helpful to students as they learn to ask each other questions about the relative quality of the various portfolio components.
2. Encourage and support student attempts to make connections. Students may need reassurance that they will be able to experience success in an assessment system that emphasizes their responsibility for learning. Their self-esteem and motivation increase because they get credit for what they know instead of being penalized for what they don't know.
3. Empathize with the students' experience. Parts of this assessment process may be incomprehensible or overwhelming to the students when viewed from their perspective. Portfolio vocabulary and ideas may be meaningless to them at first. It takes time to get these concepts across to them.
4. Be flexible in scheduling. The planning for activity completion must constantly be reevaluated and reexamined to provide responsible time for students to do their best work.

Projects that cause students to create something that can become visual reminders of a learning experience are in keeping with a brain-compatible because learning is an ongoing process. OPPORTUNITY FOR ASSESSMENT # 8 challenges students to create visual representations of the various geographic features of different regions of the United States. The performance task (creating the mobiles) provides an opportunity to evaluate student knowledge of geography. *Geography Mobiles* and all of the other assessment opportunities in this book don't call a halt to learning so that that learning can be measured. The proof of understanding is in the product. In this case, the product can hang in the classroom as a reminder of the concepts learned in that unit, providing a visual clue for students to recall the knowledge they demonstrated in constructing the mobiles. Parts of speech, geometry theorems, and chemical formulas also make for fine mobiles. Teachers should keep examples of the mobiles to show future classes. Students can be inspired by those that have gone before them and improve upon previous designs. If a group thinks of a way that they can improve their mobile, even after it's hung, teachers should allow them to make revisions as long as they continue to move forward with their new work.

Opportunity for Assessment #8

Geography Mobiles

Level Elementary

Content Standards

Social Studies (geography)

- ☐ Understands the characteristics and uses of maps, globes, and other geographic tools and technologies
- ☐ Knows the location of places, geographic features, and patterns of the environment
- ☐ Understands the concept of regions

Language Arts

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Demonstrates competence in the general skills and strategies of the reading process
- ☐ Demonstrates competence in the general skills and strategies for reading literature

Visual Arts

- ☐ Uses the structures (e.g. sensory qualities, organizational principles, expressive features) and functions of art
- ☐ Understands the characteristics and merits of one's own artwork and the artwork of others

Performance Standards

- ☐ Content: states correctly grouped and represented.
- ☐ Organization: mobile has a logical layout organization that makes the product easily recognizable.
- ☐ Creativity and originality: mobile design displays innovation and uniqueness.
- ☐ Teamwork qualities: the finished product contains equitable contributions from each of the team members.

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Working in small groups, students are to create team mobiles representing various regions of the United States. Each team will present their mobile to the class as a group, also presenting information about their chosen region.

Assessment Technique

Portfolio Assessment—to show student progress over time; allows for extended product revision and development; ongoing feedback between students and teacher (see Figure 3.3).

PORTFOLIO RUBRIC				
Qualities Evaluated	**Advanced** *Excellent and sophisticated work quality*	**Proficient** *Accomplished level of work*	**Basic** *Quality of work shows developing skill*	**Novice** *Beginning-level work quality*
Content	States correctly grouped and represented	States correctly grouped and represented	Some states grouped and represented correctly	States incorrectly grouped and represented
Organization	Layout is logical with information easily recognizable	Mobile has a logical layout	Mobile has some logic to the lay-out and organization	Mobile has no logical layout. Lack of organization makes the finished product difficult to understand
Creativity and originality	Design shows innovation and uniqueness	Mobile design displays innovation	Mobile displays some innovation in design	Mobile design displays neither innovation nor uniqueness
Teamwork	The finished product contains equitable contributions from all of the team members	The finished product contains contributions from each of the team members	The finished product contains contributions from some of the team members	The finished product does not contain equitable contributions from each of the team members

Figure 3.3

Performance Criteria

Good performance criteria help teachers and students understand the goals and target of the instruction. They help students know what is expected, what "excellence" looks like. Performance criteria also help teachers understand what kind of feedback is needed from students.

Teachers need to use different types of performance criteria to be assured of the validity and reliability of the assessment they construct. Three types of criteria are described below. *Product criteria* are used to assess the task outcome (the essay, performance, or project that students complete), while *process criteria* assess elements of the product (effort, homework, class participation). The third type is *progress criteria*, which are used to access a student's growth as he or she moves from level to level of accomplishment (from novice to proficient). Imagine assessing two students on an art project: one is a brilliant artist; the other has poor fine motor skills but is highly creative and always does her best. By only using product criteria (the appearance of the finished product), the second student may not be recognized for those things that she does well (effort). When process as well as progress criteria are part of the evaluation, fuller understanding of student achievement can be gleaned. All three of the performance criteria must be used to prevent inequities.

Assessment Design

A good performance assessment invents authentic problem situations that are rich in contextual detail. A context rich in detail supports students using multiple approaches, styles, strategies, and solutions, and good judgement. The assessment may be contrived, but it doesn't have to feel as if it is. It is realistic to the extent that it provides the *feel* of the challenge and motivates students to want to master it. The student will loose sight of the fact that he or she is doing this for a grade if the tasks presented are worth mastering.

Grant Wiggins (1992) offers the following as guidelines to use in the design of performance assessments.

1. Performance tasks should be whenever possible, authentic, meaningful, and worth mastering.
2. The set of tasks should be a valid sample from which broad and more abstract generalizations about the underlying principles can be made.
3. The evaluation criteria should be authentic, with points awarded or taken off for essential successes and errors.
4. The performance standards that anchor the evaluation should be genuine benchmarks, not arbitrary cut scores or provincial school norms.

5. The context of the problems should be rich, realistic, and meaningful to the students.
6. The task evaluation should be feasible and reliable.
7. The assessment results should be reported and used so that all those concerned with the data are satisfied.

Performance assessment in the context of brain compatibility entails *synthesizing*, putting together knowledge, experience, and skill. Knowledge synthesizing tasks require students to use everything they know to bring about a creative resolution to the problem presented. Such tasks are therefore:

- Complex (the total plan or strategy is not easily seen)
- Yield multiple and often "messy" solutions (each with its own cost and benefits)
- Entail nuances in student judgement and interpretation
- Encompass the application of multiple criteria (which can, at times conflict with one another)
- Involve uncertainty (all information regarding the task may not be given)
- Require student self-regulation of the thinking process
- Involve the ability to find structure in apparent disorder
- Require effort and considerable mental work on the part of the student

To further evaluate the quality and value of a potential performance assessment the activity or task that the student is to undertake should

1. Afford students more than a single solution or strategy
2. Require more of students than simply the reproduction of a skill or a recollection of facts
3. Promote student learning from performing the assessment
4. Allow teachers to ascertain the level of student knowledge created by student effort

To build a task and a means for evaluating a student's performance on that task, teachers must define the standards (both performance and content) by which the task is to be evaluated. Teachers must thoroughly detail how the task should be administered, how the task should be carried out, the expectations, and provide exemplary samples of achievement so that everyone involved is clear on what "excellence" looks like. Before students begin the performance task, any interventions or guidance by facilitators must be done without compromising the validity and integrity of the task being assessed.

Beyond the Answer Key

An evaluation should reflect what is most important about doing an effective job, not what is easiest to score. A growing number of teachers recognize the value of using rubrics as instructional tools. To implement a scoring system that is as authentic as the task being scored, teachers must look beyond the traditional answer key. Learning to use rubrics (benchmarks and checklists included) will help teachers judge student work fairly and communicate their expectations to both students and parents. Such methods of evaluation are clear and logical, rather than vague and mysterious like other more traditional methods of scoring. Students and parents alike know before the start of the task what "excellence," or "good," look like (see Rubric Template Figure 3.4).

RUBRIC TEMPLATE

Point Value **Criteria Evaluated**	**Advanced** ***Exemplary*** 4	**Proficient** ***Accomplished*** 3	**Basic** ***Developing*** 2	**Novice** ***Beginning*** 1	***Score***
Quality or characteristic	Description of identifiable characteristics reflecting an exemplary level performance	Description at an accomplished level	Description at a developing level	Description at a beginning level	
Quality or characteristic	Description of identifiable characteristics reflecting an exemplary level performance	Description at an accomplished level	Description at a developing level	Description at a beginning level	
Quality or characteristic	Description of identifiable characteristics reflecting an exemplary level performance	Description at an accomplished level	Description at a developing level	Description at a beginning level	
				Total Score =	

Figure 3.4

Rubrics

Rubrics (guides that give direction to the scoring of student products and/or performances) should represent generalizations about traits found in an array of actual performances. Rubrics help to create scoring systems that are easy to learn and use. They help students assess their place on the achievement scale and indicate what is needed to improve their performance. The same rubric can be used throughout the year to document a pattern of performance and progress.

Presentation rubrics, which students use to evaluate each other's performance, help learners to make their own work conform to the desired performance levels. Scoring rubrics are often supplemented with performance samples that serve as concrete standards against which other samples may be judged. Benchmarks are generally provided for each achievement level.

A rubric is fundamentally a matrix upon which teachers can convey answers to the following questions:

- What are the student performance goals?
- Exactly what does the student know based upon benchmarked standards?
- What constitutes evidence of student understanding?
- What does mastery of the task look like?
- What errors would justify lowering a score?

Figure 3.5 charts each of the evaluation techniques used throughout this book.

Evaluation Tools	**As Illustrated by**
Group Presentation Rubric	Figure 4.1
Observation Rubric	Figure 2.3
Paragraph Assessment Rubric	Figure 2.4
Performance Assessment Rubric	Figures 5.5, 6.4
Portfolio Evaluation Rubric	Figures 1.3, 2.7, 3.1, 3.3, 4.4, 4.7, 5.2
Presentation Rubric	Figure 6.7
Scoring Rubric	Figure 1.6, 3.4, 3.7, 5.4
Student Self-Assessment Outline	Figures 1.4, 5.3, 6.1, 6.8
Two-Level Rubric	Figure 2.1

Figure 3.5

Consistent Scoring and Reliability

The use of human evaluators raises concerns about the reliability and consistency of scores based on the judgement of an individual. The expense and the time involved in scoring such authentic assessments have also caused concern. In an effort to deal with these issues, new scoring tools and methods are constantly being developed and improved to go along with new assessments.

Some school districts have worked out complex auditing schemes to ensure inter-rater reliability. *Blind scoring*, evaluation of a performance task without direct contact with or knowledge of the person being evaluated, may also be used. A simple yet effective way to check consistency is to reevaluate a few papers from the top of the pile after a whole stack has been scored to guard against applying a sliding standard.Evaluators can score student work in one of two ways, holistically or analytically. *Holistic scoring* is an evaluation system based on the overall impression of a sample of student work viewed as a whole. This system produces a single number, typically based on a zero to four, or zero to six, point scale, and is used when a relatively quick yet consistent scoring method is needed.

Analytical scoring involves the awarding of separate scores for different qualities or traits of a student's work. This type of scoring, while much more time consuming than holistic scoring, provides more detailed information. Because analytic scoring can best pinpoint areas in need of improvement, it is often used for diagnostic purposes or curriculum and instructional program evaluation.

Students as Evaluators

One of the greatest differences between classrooms that use performance assessments and those that do not is the degree to which students engage in reflection and metacognition. Through the process of reflection, students become increasingly aware of themselves as learners. For many students, reflection is an entirely new skill requiring a great deal of specific instruction and support. The teacher's role is to foster reflection by helping students learn to identify the characteristics of high quality work (what excellence looks like) and then recognize it in their own work as well as in the work of others. Reflection involves the description of methods and results, as well as assessments of new learning. With help in developing a vocabulary to discuss what they observe, student comments can become more sophisticated and reveal higher level thinking and metacognition. Teachers can use the following words to construct open-ended questions that elicit student reflection.

Analyze
Compare
Contrast
Define
Demonstrate
Describe
Examine
Explain
Explore
Express
Illustrate
Investigate
List
Present
Prove

It is important to keep in mind that if students are not made to understand the use of rubrics and other assessment tools before they begin a performance assessment, much of the benefit of the actual experience will be lost or wasted.

Content Counts

Care must be taken that content is not overlooked when emphasizing student performance. Students may be creating, but they may not be gaining understanding of content. Maintaining learning content is critical because learning is more than merely doing enjoyable project work. If too much emphasis is on doing fun things to the neglect of content, the substance of the learning will become ambiguous, vague, or even absent altogether.

It is part of an educator's job to stress with parents that the use of brain-compatible authentic assessment is not devaluing or reducing content, but rather, it is expanding it so that students are able to apply the knowledge they learn. The need to reassure parents reflects the challenge of gaining public support for performance assessments. Today's parents grew up in a norm-referenced system, and that remains their frame of reference. Parents need to be made aware that performance assessments complement traditional tests; they aren't meant to replace them. Communicating the results of performance assessment to parents can sometimes pose a challenge for educators. Figure 3.6 Parent Communication and Reflection Letter can improve school/home communication by providing a way of initiating and establishing parental involvement. Research has shown that when parental involvement becomes part of the learning process, students have a higher success rate than when parents are not involved.

Parent Communication and Reflection Letter

Dear Parent or Guardian,

Student self-assessment is a dynamic and positive learning tool. Its effectiveness lies in the fact that it helps students to:

- Develop responsibility for their own learning
- Become motivated for improvement
- Internalize criteria for success
- Learn to use assessment for growth
- Think reflectively

The performance assessment process used in this class requires both student and teacher input. The process uses observations and judgments to evaluate performance based on clearly defined criteria. We invite you to be part of this performance assessment process.

Please look over and read everything in your child's portfolio. Each piece is accompanied by his/her performance assessment. The portfolios also include reflections and self-evaluations.

When you have read the portfolio, please discuss the work with your child. The following questions can help guide you in the discussion.

Which piece(s) of work in the portfolio tells you the most about his/her critical thinking or problem-solving skills?

What does it tell you?

What do you see as the strengths in your child's thinking skills?

What do you think needs to be addressed in your child's growth and development?

Other comments, suggestions

Thank you so much for investing this time in your child's education!

Figure 3.6

Educational Inferences

There are no real absolutes in assessment. The benefits of using brain compatible standards-based assessment tools for students, teachers, and parents are numerous. Learners are empowered to achieve success when they know what is expected of them *before* they begin the task. When students clearly understand what is expected, they can strive to meet or exceed expectations. Students develop enhanced cognitive (knowledge-based) and metacognitive (introspective) processes because the known criteria allow for the self-monitoring of work.

Graphing activities enhance both cognitive and metacognitive processes. They are most challenging and meaningful when students collect the data and construct their own meaning from that data. OPPORTUNITY FOR ASSESSMENT # 9: Class Pet Diet Graph is a chance for students to gain understanding through the application and use of real-world situations (real pets and their actual food and water intake). Students at all levels can use this activity to their advantage. Secondary students can formulate theories and predict future outcomes from the data they've collected. In addition, they can collect data about the weight of the animals relative to their food intake and then construct appropriate ratios. Or they can observe the effect different brands of pet food have on the animal's weight and digestion. Elementary students can record and graph single elements of intake (just food pellets). They can create a pictograph were each actual pellet affixed to the graph represents ten pellets fed to the class rabbit for example.

Opportunity for Assessment #9

Class Pet Diet Graph

Level Middle

Content Standards

Science (life sciences and scientific method)

- ☐ Knows about the diversity and unity that characterizes life
- ☐ Understands the nature of scientific knowledge
- ☐ Understands the nature of scientific inquiry

Mathematics

- ☐ Understands and applies basic and advanced properties of the concept of mathematics
- ☐ Understands and applies basic and advanced concepts of data analysis and distribution

Performance Standards

- ☐ Knowledge of Data-recording Methodology
- ☐ Accuracy of Data Recording
- ☐ Accuracy of Graphic Representation
- ☐ Clarity of Graphic Representation

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☑ Logical/Mathematical
- ☐ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☐ Bodily/Kinesthetic
- ☐ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☑ Naturalist

Performance Task

In small groups, students will make and record observations about the food and water intake of classroom pets over an extended period of time. Students will then graph the data.

Assessment Technique

Scoring Rubric (see Figure 3.7).

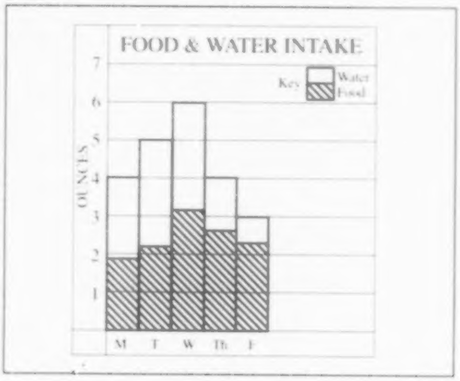
RUBRIC FOR ACCURATE DATA RECORDING

Qualities Evaluated	**Advanced** ***Quality of work is superior and complex***	**Proficient** ***Quality of work is satisfactory (adequate)***	**Basic** ***Quality of work is partially acceptable***	**Novice** ***Quality of work is poor (inadequate)***
Knowledge and accuracy of data recording methodology	Graph displays a sophisticated level of understanding Data is accurately and meticulously recorded	Displays solid understanding of recording methodology Data is recorded accurately	Displays incomplete understanding of recording method Some inaccuracies	Displays no understanding of recording methods Profound inaccuracies
Accuracy and clarity of graphic representation	Sophisticated use of graphing to visually represent data Clarity of graphic representation allows for sophisticated inferences and extensions to be created	Correct graph choice and construction Graph is easy to understand	Faulty construction of correct graph type Graph makes some sense	Faulty construction of graph and/or incorrect graph type used Graph makes little or no sense

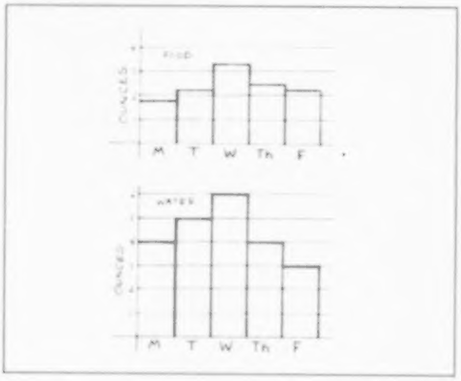
Figure 3.7

Student Samples (Figure 3.8).

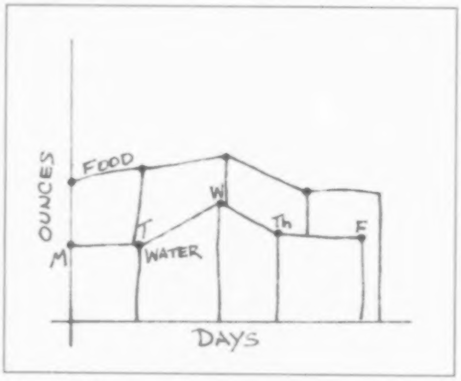
Advanced



Proficient



Basic



Novice

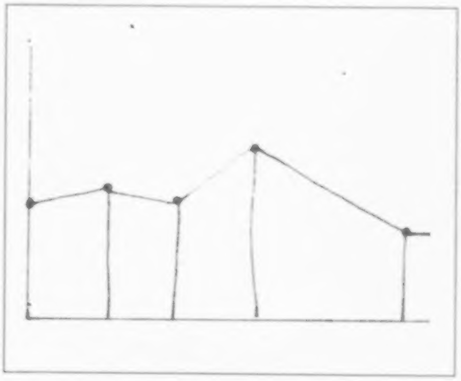


Figure 3.8

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CHAPTER 4

WIRING THE CURRICULUM

STANDARDS AND THEIR TECHNOLOGICAL APPLICATIONS

Technology (when used wisely) is an enabler, motivating students to achieve, to excel, to think, and to learn. Study after study documents the effectiveness of multimedia technology, teasing reluctant learners into the content of the material, sometimes with astonishing results [but] when technology becomes an end in itself, it becomes the dark side of the moon. —Susan Veccia 1995, 6

Interactive Learning

One of the best ways to encourage a transformation from the behaviorist reward/punishment mode to a more brain-compatible paradigm is through the use of technology, namely the computer. The technological world in which children grow up today is very different from the one in which today's adults grew up. Just about every child in the United States interacts daily with an assortment of technology and information media via television, video games, audio and videotapes, compact discs, or multi-media computer systems just to name a few. At the same time, the workplace is gearing up for advanced technologies and complex, comprehensive information systems needed to streamline business operations.

It would seem only logical that since young people have had such repeated exposure to technology, they would have an easy transition into the technology-rich workplace. Unfortunately, reality demonstrates otherwise. According to projections, only about twenty-two percent of persons currently entering the labor market possess the technological skills that will be required for sixty percent of new jobs (Zuckerman 1994). To eliminate such a discrepancy, it is up to the schools to take the initiative and step up to this new interactive information age as quickly and expeditiously as possible.

The Many Uses of the Computer

Computers are tools that can be used to great advantage by educators to enhance the learning opportunities and learner inquiry across all content areas. The following lists the ways in which computers can be used to complement teacher instruction.

Drill and Practice

Drill and practice software is usually used for repetitive applications of skills such as practice and review of newly acquired subject vocabulary or mathematics facts. These programs reinforce the concepts taught in class in a way that is entertaining and age appropriate. A computer never gets angry or impatient; its pace adapts to the student using it. Slower students may type in as many requests for assistance as necessary, while advanced students may skip parts of a program that they already understand. It is important to bear in mind that drill and practice have limited usefulness because only surface knowledge is being reinforced, not high level thinking skills.

Dialogue and Tutorial

Computer tutorials serve to involve students in an active dialogue. A topic is introduced, and various concepts are "taught" by presenting principles from step A, to step B, to step C, and so until the conclusion of the lesson. Students are required to answer correctly before they can proceed to the next step. If a student answers a question incorrectly, he or she is returned to a lower level. A review is then given to see if the student has mastered the lesson. Such computer activities are consistent with brain-compatible learning and the reinforcement of prior knowledge.

Simulation

The best way for elementary or middle school students to learn something is through firsthand experience; however, since this isn't always practical, cost-effective, or safe, simulation and modeling are the next best methods. When the learner is an active participant rather than merely a passive observer, the computer activity is called a simulation. In computer simulation, students collect data, correlate results, and learn skills, attitudes, and concepts. The teacher acts as a guide to help the students understand the relationship between simulation and reality. Simulations have great potential because the computer can simulate activities that are difficult or impossible to do in the classroom. Students enjoy involvement in the graphic animated displays. In simulation environments (like on-line MOO's—Multi-Object Oriented multiple user domains), students find themselves placed in situations where they control the environment by interacting with the computer. Simulations are consistent with the brain-compatible principle that learners construct their own unique concepts through active participation and meaning making. Studies show that the educational benefits of computers are greatest when they are used in sophisticated ways such as simulations and applications (i.e. spreadsheet programs that allow for student manipulation and analyses of data) rather than drill and practice. It is when teachers use the computer to teach higher-order thinking skills that students benefit the most (Wenglinsky 1998).

Data Retrieval, Analysis, and Application

The highest level of thinking and learning takes place when problem solving and decision making are being carried out. Software is available for developing these problem-solving and decision-making skills. Many science lab programs use the computer as a tool to aid in research and discovery and help to develop analytical skills that might otherwise be neglected. When students are taught to use the computer to store and retrieve data, communicate, aide in their analysis, prepare graphs, and write summary reports, they are using them authentically, the way scientists and researchers use them in the real world.

Teacher and Student Word Processing

When exploration of a project encourages student writing, the use of a word processor allows them to compose, revise, add, and remove text without being distracted by the fine motor aspects and tedium of forming letters. Word processing allows students to get messy with their writing and to take chances. Because they can remove or rearrange text, they are more free to express themselves when revision isn't so time consuming. However, reliance on word processing programs should not be a substitute for the substantial planning needed for truly proficient composition (Neuwirth 1990).

Standards, Accountability, and Technology

Over the years, social scientists and educational researchers have advocated the transformation of classrooms from passive to active environments. In order for today's young people to become competitive in tomorrow's marketplace, they will need something more substantial than yesterday's pedagogical methodology.

The President's Educational Technology Challenge set forth in 1995 recognized that some sixty percent of America's newly created jobs in the twenty-first century will require technology skills. The goal of the initiative is to ready young people for the demands of the technological workforce by mandating technological literacy. To this end the four pillars, or challenges to the country's educators, parents, and business leaders, were established. The pillars upon which the new technological literacy will be built (U.S. Department of Education 1995) follow.

PILLAR I

Modern computer and learning devices will be accessible to every student.

To make technology a viable educational tool, schools must have enough computers to provide full, easy access for all students, including students with disabilities. Although the national student-to-computer ratio is currently eleven to one, the ratios of students to powerful multimedia computers is thirty-five students to every one and a half machines. Full, easy access requires a ratio of about five students to every one multimedia computer.

PILLAR II

Classrooms will be connected to one another and the outside world.

Connections to local area networks (LANs) and the Internet turn computers into versatile and powerful learning tools. Access to these networks introduces students and teachers to people, places, and ideas from all over the world, ideas to which they might not otherwise be exposed.

PILLAR III

Educational software will be an integral part of the curriculum and as engaging as the best video game.

Software, video, distance learning courses, and online resources are expanding rapidly. (There are more than 20,000 available educational software titles, more than a million students take courses through distance learning networks every year, and every day hundreds of new home pages are added to the Internet.) Such resources hold promise to improve learning, increase the amount of time students spend learning, and engage students in problem solving, research, and data analysis, all of which help foster a brain-compatible learning environment.

PILLAR IV

Teachers will be ready to use and teach technology.

Professional development is the key to effective technology integration as well as increased student learning. Teachers need access to technology and ongoing support while they learn. Further, they need adequate time to acquire the skills necessary to integrate technology into their school's existing programs and activities. The Office of Technology Assessment estimates that it can take up to five years to effectively infuse technology into schools.

Beyond the hype and rhetoric surrounding interactivity in education, there is solid empirical analysis supporting the benefits of such brain-compatible interactive learning. Simply put, students of all ages learn better when they are actively engaged in the learning process, whether that process comes in the form of a sophisticated multimedia package or a low-tech classroom debate on current events.

The urgent need for and emphasis on interactivity in the learning process is directly linked to the brain-compatible contention that each learner actively creates his or her own knowledge through direct and *meaningful* experience. In a school demonstrating interactivity, students communicate with other students through formal presentations, cooperative learning activities, and informal dialogue. Students and teachers communicate about their learning tasks in large groups, small groups, and one-to-one. Students have open access to and know about print and electronic information resources to inform their learning activities. They recognize the value of the information sources in their own communities and interact with community members to enhance their curricular studies with authentic information from primary sources.

The reason traditional expository teaching tends to turn students off is the lecture style of presentation. Brain-compatible research shows that students need to be involved in the teaching/learning process to successfully expand their understanding of a given subject. The act of physically producing a physics experiment while also exploring the social context in which the original experiment was performed, will hold more interest for students and have more educational value than listening to a lecture about how that same experiment was attempted centuries before. Learning becomes meaningful only after each learner has constructed his or her personal meaning from the experience itself.

By initiating their own learning, students are able to participate in productive questioning and probing for information that they can use immediately rather than waiting for the next question on a test or from a teacher. Information resources such as the Internet are central rather than peripheral to day-to-day learning activities. Through the use of brain-compatible, problem solving activities, students learn to gather their own data, and then examine that information so that they can synthesize, analyze, and interpret it in the context of the problems or questions they have identified.

Having students explore information through a variety of different instructional approaches often results in their becoming more interested and receptive to the subject they are studying. Because the brain is functioning with greater efficacy through these varied approaches, students are able to invest more of their mental energy in the learning and thereby commit concepts to memory with greater comprehension. Research shows that students who talk about how they and others think become better learners. When encouraged and given the opportunity and medium, students are willing to express opinions on almost any subject. By giving them the chance to articulate and share their thoughts, they are able to develop a more sophisticated understanding of a subject's meaning and relevance.

OPPORUNITY FOR ASSESSMENT #10: *Tessellation Transformation* offers a sophisticated performance task for secondary level students that calls the electronic manipulation of geometric shapes. The product serves as proof that the process was performed accurately. This task allows teachers to measure a student's level of technological proficiency and their understanding of geometric concepts, all without so much as putting pencil to paper. Middle level students can gain understanding of geometric shapes by creating them on the computer using any number of software programs. Elementary students can learn to identify many-sided figures by using commercially available or teacher constructed software programs.

Opportunity for Assessment #10

Tessellation Transformation

Level Secondary

Content Standards

Mathematics (geometry)

- ☐ Effectively uses a variety of strategies in the problem-solving process
- ☐ Understands and applies basic and advanced properties of the concepts of geometry
- ☐ Understands the general nature and uses of mathematics

Technology

- ☐ Students will use appropriate technologies to create written, visual, oral, and multimedia products to communicate ideas, information, or conclusions

Language Arts (descriptive and reflective writing)

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Demonstrates competence in the general skills and strategies of the reading process
- ☐ Demonstrates competence in using speaking and listening as tools for learning

Visual Arts

- ☐ Uses the structures and functions of art
- ☐ Understands the characteristics and merits of one's own artwork and the artwork of others

Performance Standards

- ☐ Knowledge
- ☐ Organization
- ☐ Presentation

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☑ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☐ Interpersonal/Social
- ☑ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Working in pairs, students create a series of tessellation designs from assorted basic geometric shapes. Students first experiment with single, unmodified shape tessellations and then go on to the intricacies of more sophisticated tessellation metamorphoses. The activity ends with a group competition for the most original and creative tessellation metamorphosis design.

Assessment Technique

Group Presentation Rubric (Figure 4.1).

Group Presentation Rubric for Use in Peer Evaluation

Part 1: Plan Content

Knowledge

_____Apparent strong knowledge of content and subject
_____Able to answer relevant, appropriate questions if asked

- Were all the objectives for this assignment carried out by the team (individual)?

____ Does the unit topic have clear goals?
____ Is there a unit rationale?
____ Are the activities presented engaging?
____ Does the presentation hold together?
____ Are there clear unit objectives?

- How were these objectives carried out?
- Were visual aids provided? Were they helpful?
- How did or didn't they add to the presentation?

Organization

_____Logical, sequential order to presentation
_____Interesting beginning
_____Informative middle
_____Strong conclusion
_____Well planned (not done "off the cuff")
_____Interactive presentation (audience involvement)

Part 2: Presentation Skills

Superior Presentation (What excellent looks like)

_____Excellent eye contact with entire audience
_____Clear articulation (speaks clearly)
_____Clearly audible (easily heard)
_____Appropriate hand gestures and expressions
_____Good supportive materials (charts, diagrams, posters)
_____Demonstrates confidence

Comments:

Figure 4.1

Student Self-Evaluation

Excellent (E)

_____ The tessellation was unique, creative, well organized, easy to understand, and displayed interesting and creative insights

_____ The geometric shapes tessellated accurately, were easy to discern, and were carried beyond the basic requirements for this project

_____ Both team members were extremely well-prepared and contributed equally to the presentation discussion

_____ The coloring of the tessellation was sophisticated and contributed to the intricacy of the design

Satisfactory (S)

_____ The tessellation seemed adequate, but was not especially creative or unique

_____ Most of the shapes tessellated accurately

_____ Both team members contributed to the presentation discussion

_____ The coloring of the tessellation enhanced the design

Unsatisfactory (U)

_____ The tessellation appeared disorganized and was difficult to understand and/or follow

_____ The shapes did not tessellate accurately

_____ The presentation of the discussion was not done equally

_____ The tessellation was not colored, or the coloring detracted from the total design

In the space below, write several paragraphs to explain the reasons you gave the grade you did. Be sure to critique the presentation as well as the tessellation.

Figure 4.2

Student Work Samples (Figure 4.3).

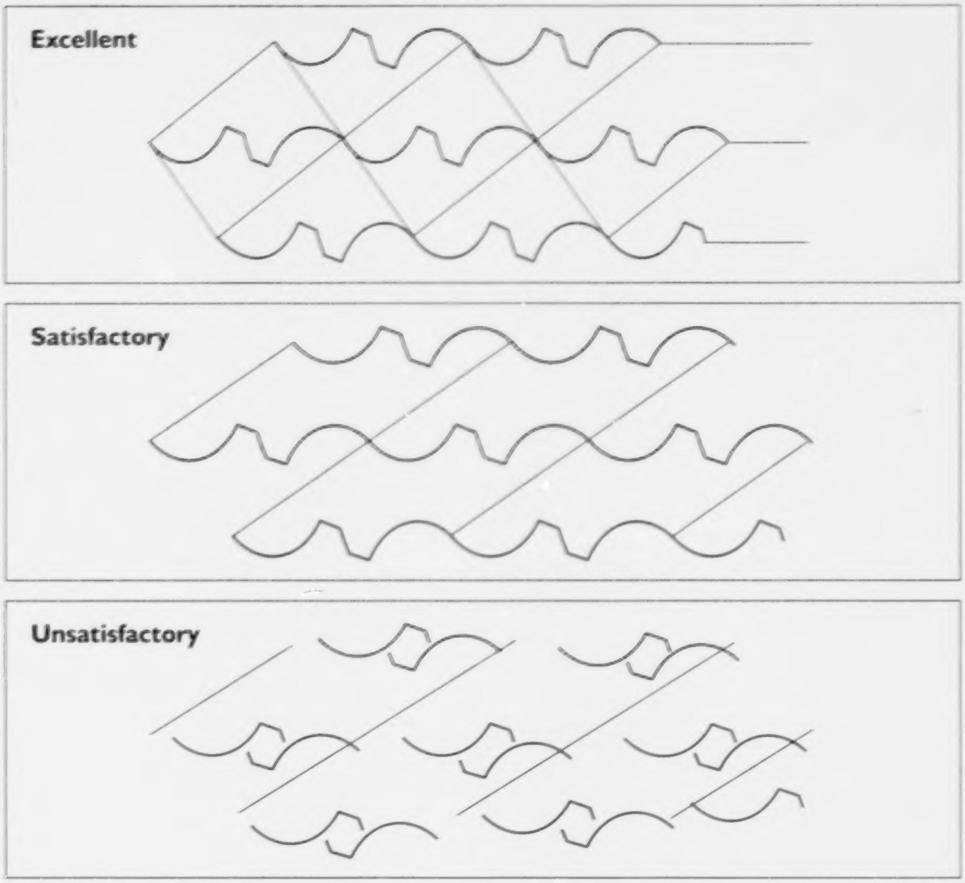


Figure 4.3

In Perspective

Don Tapscott, in his article, "Educating the Net Generation" (1999) lists eight ways in which educators must shift their perspective to be in step with interactive learning.

1. From linear to hypermedia learning.

Traditional educational approaches were intended for the reading of printed material and textbooks, designed to begin at the beginning and continue straight through to the end. Today's children have evolved with a more global perspective, experiencing ideas that often come simultaneously from different vantage points.

2. From instruction to construction and discovery.

With new technologies, pedagogy has begun to shift from the traditional perspective to one in which "learning partnerships and learning cultures" are created and nurtured.

3. From teacher-centered to learner-centered education.

The focus of learning is now shifting from the transmitter to the individual, from a passive to a more active approach in which students discuss, debate, research, and collaborate.

4. From absorbing material to learning how to navigate and how to learn.

Learners must go beyond knowledge analysis and move into the area of knowledge synthesis.

5. From school to life-long learning.

Today knowledge is increasing at such an exponential rate that is difficult for anyone to keep pace with it all. It will become impossible for the citizens of the twenty-first century to learn all they will need for life while still in school. To cope with such a knowledge explosion, students must instead learn how to update and revise their knowledge base throughout their lifetime so as to keep pace with all the changes they will encounter.

6. From one-size-fits-all to customized learning.

Today's technology allows students to have customized learning experiences based on their backgrounds, individual talents, age levels, cognitive styles, and preferences.

7. From learning as torture to learning as fun.

When brain-compatible instructional methodologies are employed, a learner's innate curiosity can be linked to the wonder of discovery, transforming his/her perception of learning from one of work to one of pleasure.

8. From the teacher as transmitter to the teacher as facilitator.

With the teacher taking a back seat to the students in the students' construction of their own new knowledge, the teacher's role has been transformed from "sage on the stage" to one of "guide on the side."

Technology without Borders

Many schools have yet to invest wholeheartedly in instructional technology, preferring instead to place computers in a single room where students use them once a week under a specialty teacher's supervision. In an effort to provide computer access to all students at an affordable cost, technology has come to be viewed in many schools and districts as a separate subject isolated from the rest of the curriculum in a "laboratory-style" arrangement. Such fragmented thinking is reminiscent of the Newtonian paradigm where knowledge is broken down into parts and then delivered in assembly-line fashion. For technology to be truly integrated, computers must take their rightful place in the classroom next to books, desks and chairs, and students, for in today's classrooms they are just as necessary.

Isolation and infrequent access have undermined the single most valuable aspect of the computer, its ability to cut across traditional subject boundaries as a practical and useful tool. Dr. Seymour Papert (1993) compares the elementary school's isolation of computers in labs to the body's immune response to a foreign intruder. By turning the technology into a separate, unrelated subject area called "computer literacy," schools have effectively minimized the potential impact computers can have on young peoples' learning.

The "laboratory" approach allows students to have access to about one-fiftieth of a computer in school, far from the critical level of one multimedia computer for every five students the President's Educational Technology Initiative suggests. However, it is only with significant access that technology can have a major impact on educational practices or students' learning experiences. The fatal flaw in keeping computers separate from the everyday classroom environment is that any information learned about the computers today will be obsolete by tomorrow (Papert, 1993). It is only when computers are truly integrated into the curriculum (put in to context) that students will gain the most valuable computer skill of all, the ability to use the computer as a natural tool for learning.

The OPPORTUNITY FOR ASSESSMENT # 11 challenges elementary students to create a "map" that gives visual directions on how to use a CD-ROM disc. The creation of maps, diagrams, and flow charts to depict operations (especially mathematical and technical ones) can be especially instructive for non-mathematical/logical thinkers because it actually creates a picture of the concept, helping those more inclined to visual/spatial learning. Further, writing about the process brings in verbal/linguistic learners and allows for self-reflection about the learning that has taken place during the performance of the task. *Multimedia Mapping* can be modified to suit other levels by keying in to content standards for those levels. Middle and secondary level students can diagram more complex operations like the creation of a spreadsheet. Advanced students might create a flow chart using presentation software showing the organization of a computer program of their own design.

Opportunity for Assessment #11

Multimedia Mapping

Level Elementary

Content Standards

Technology

- ☐ Students will use appropriate technologies to create written, visual, oral, and multimedia products to communicate ideas, information, or conclusions

Mathematics (geometry)

- ☐ Effectively uses a variety of strategies in the problem-solving process
- ☐ Understands the general nature and uses of mathematics

Language Arts (descriptive and reflective writing)

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Demonstrates competence in the general skills and strategies of the reading process
- ☐ Demonstrates competence in using speaking and listening as tools for learning

Performance Standards

- ☐ Identifies and includes all of the steps in the process
- ☐ Sequentially Ordered
- ☐ Creativity and Care of Presentation
- ☐ Comprehension
- ☐ Teamwork

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☑ Logical/Mathematical
- ☐ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

In pairs, students will create a map showing the way to use a CD-ROM program. Every operation should be accounted for from turning the machine on to quitting the program and putting it back where it belongs.

Assessment Technique

Scoring Rubric (see Figure 4.4).

PORTFOLIO RUBRIC				
Qualities Evaluated	**Advanced**	**Proficient**	**Basic**	**Novice**
Steps Included	Very detailed step-by-step presentation	All necessary steps included	Steps left out	Many steps left out
Sequentially Ordered	Sequentially ordered	Most sequentially ordered	Some steps out of order	Steps were not sequentially ordered
Creativity and Care of Presentation	Very creative and inventive presentation	Carefully and neatly presented	Not very neatly presented	Not presented neatly and lacked creativity
Comprehension	Demonstrates clear understanding of process	Shows evidence of overall understanding of process	Showed little understanding of the process	Demonstrates no understanding of the process or task
Teamwork	Pair worked well together at all times, equally contributing to the success of the product	Pair was able to work cooperatively at all times	Pair worked well together for the most part	Pair did not work well as a team

Figure 4.4

SOFTWARE and SERVERS and SEARCH ENGINES, Oh, My!

Technology, specifically the computer, opens a world of opportunities for the classroom. However, technology, as with any other tool, is only as good as the way it is used. A study conducted by Harold Wenglinsky, using 1996 NAEP scores, concluded that even minimal technology training for teachers had a strong impact on student achievement. It is not surprising then that such teachers were more likely to use computers in their classrooms more effectively than teachers who had no training at all. It seems right then to conclude that "more elaborate training might post even greater gains" (Wenglinsky 1998). Those teachers who have not had training cannot afford to sit on the technological sidelines. Trepidation and lack of training, where computers are concerned, on the part of some teachers can be an opportunity to use a different and more brain-compatible pedagogy. Students should be encouraged to take the lead in making their own pathways to understanding the emerging technology. When the power of technology is placed in the hands of the students, they have more authentic learning experiences, construct their own meaning from their investigations, and gain confidence in their abilities to solve problems. Further, "having teachers and [students] learn and work together also models the community of learning and the community of leadership" exemplifying what cooperative, multiple-intelligence based, brain-compatible learning is all about (Maurer and Davidson 1999, 459).

The Role of the Teacher

To develop self-initiated learners in the interactive, technology-oriented classroom, the teacher's role needs to evolve from one of fact-dispenser to the subtler role of coach and guide. In this continuously shifting role, teachers leave fact-finding to the computer and instead spend their time doing what they were meant to do, act as content experts through arousing curiosity, asking the right questions at the right time, and stimulating debate and serious discussion around engaging topics.

Instructor

When the computer is introduced into the classroom, an initial learning period occurs during which the young learners need time to become familiar and comfortable with the technology. It is during this period that the teacher needs to assume the most active role in instructing students, guiding them through new software and encouraging their exploration of the material.

Coach

As the students become more experienced with computers, the role of the teacher as technology tutor gradually changes to one in which the students are able to perform tasks independently, and peers begin to take over the role of instructor. The teacher then moves into the role of facilitator, providing guidance and support when needed and ensuring appropriate classroom behavior, while control of the situation passes more and more into the hands of the students.

Model

Students will be much more likely to use the computer as a practical, integrated tool for learning if they see the teacher doing the same. Using the computer during large and small group instruction and for recording stories and producing classroom signs and charts are ways in which the teacher can be a highly visible user of technology.

Critic

Responsibilities of the teacher in the computer-enriched classroom begin before the computer is introduced to the students. In providing a rich, challenging, and appropriate learning environment, teachers must take an active role in selecting the software that will truly enhance student learning and development. (See Figure 4.5 "Software Evaluation Outline" for a tool in the software use and selection process.)

World Wide Web Traveler

The Internet provides a rare opportunity for educators to engage in informal discussions on teaching strategies and a source of professional development. Traditionally, each classroom had been considered an island unto itself, with the teacher instructing, assessing, and remediating students independently from other teachers, even those within the same school. Networking now allows teachers to exchange lesson plans and advice as well as debate instructional methodologies with peers around the world with just a keystroke. Instead of having to wait for summer conferences on education reform, educators can now compare and contrast their work with relative ease and speed. In a sense, the Internet has electronically created a professional fraternity among educators.

Software Selection

Despite changing and evolving classroom roles, it is still the responsibility of the teacher and the schools to select appropriate material for use in the classroom. Teachers must review and evaluate all the software before they expect students to use it. Rating systems such as those provided by the Entertainment Software Rating Board (ESRB) or the Recreational Software Advisory Council (RSAC) were developed by independent groups in conjunction with software publishers and can give educators a clue as to what a software title is all about. Labels on software and some Web sites alert consumers to the content and age appropriateness of material. They do not provide a quality or meaningfulness rating; that is up to the teacher or school's review committee to decide. The Software Evaluation Outline (Figure 4.5) provides a framework for comparison of software titles by teachers.

The Internet

The easiest way for an educator to introduce the Internet into his or her classroom is by adding Internet components to already established lesson plans. While not all lesson plans allow themselves to be easily "Internetized," many others can be readily adapted. Making the Internet an everyday classroom activity, however, can be a two-edged sword. If undirected, students can become so engaged in using the Internet's extensive resources that too much time may be taken from other classroom activities. Therefore, it is best to start with a plan that first meets educational objectives, and then modify that plan so that it will take advantage of on-line communication and navigational tools.

Lesson plans that make the leap into cyberspace the best are those involving:

- Research on a particular topic
- Comparing and contrasting of information
- Information gathering from human sources such as other students or experts;
- Critical thinking and analysis
- Researching and writing a report
- Use of graphics and art
- Collecting and analyzing data and building a database
- Conducting a survey through questionnaires
- Working in teams

After selecting those lesson plans that have the most potential, teachers can log onto the Internet and locate resource links that can be included in

SOFTWARE EVALUATION OUTLINE

1. Computer

☐ Macintosh ☐ P.C. ☐ Other

2. Cost

Single package: $ ____________ Network: $ ____________

Total cost: $ ____________ Cost per student: $ ____________

3. Instructional Strategy (Check box if present)

a. Educational adventure ☐
b. Problem-solving ☐
c. Simulations ☐
d. Tool-based (word processors, spreadsheets, etc.) ☐
e. Educational games ☐
f. Tutorials ☐
g. Drill-and-practice ☐

4. Examining the Software (Circle the correct response.)

a. Does the Software match the objective?	Yes	No
b. Is the program content accurate and well designed?	Yes	No
c. Is the content relevant and current?	Yes	No
d. Does the program offer a complete learning package, including a teacher's guide?	Yes	No
e. Is the program easy to use?	Yes	No
f. Is the program design flexible?	Yes	No
g. Are there multiple loops for the students to try?	Yes	No
h. Are prerequisite skills needed?	Yes	No
i. Is the reading level appropriate?	Yes	No
j. Can the teacher customize the program to meet student needs?	Yes	No
k. Are supplementary materials needed?	Yes	No
l. Are there suggestions for integrating it into the curriculum?	Yes	No
m. Are the graphics direct, attractive, and appropriate?	Yes	No
n. Has the software been reviewed or recommended?	Yes	No
o. Is the software and courseware program correlated with any textbooks you use?	Yes	No

p. How is the software content or teaching techniques correlated with subject content and processes that are your goals?

Figure 4.5

each lesson. The Internet Lesson Plan (Figure 4.6) is a way for teachers to outline their Internet project ideas.

Site Selection on the World Wide Web

The Internet provides access to information that is only a "click" away. While many Web sites frequently change their Internet address (or URL—Uniform Resource Locator) or cease to operate all together, libraries, government agencies, and large corporations, for the most part, provide highly stable sites. Unfortunately, not all Web sites are of consistently high quality. The following guidelines can help in the selection of quality Web sites.

Desirable sites:

- have clearly identifiable sources, purpose, and content
- are easily accessible in that the site loads quickly and displays accurate, regularly updated information
- provide active hyperlinks to other sites to extend research capability
- are free of any cultural, racial, religious, or gender bias

To help guide parents and teachers in the selection of Web sites, software (such as WebCompass) offers searching tools that can seek out specific content, are able to locate and categorize relevant sites, and summarize their content. Books such as Mark Treadwell's *1001 of the Best Internet Sites for Educators* (1999) can also save a lot of time and energy surfing sites. The American Association of School Libraries (AASL) site at *www.ala.org/ICONN/curricu2.html* and the Mid-continent Regional Educational Laboratory (McREL) site at *www.mcrel.org/connect/plus/critical.html* offer evaluative criteria for education-based Web sites and strong links to related sources. Student safety and privacy on the Internet should be of paramount concern to educators. Even though most schools have some type of censorware, a filtering program used to block access to some objectionable Web sites, teachers must monitor what sites students visit, at least while they are at school because these programs are not always failsafe. One way to save time and to keep students away from offensive or inappropriate sites is to bookmark those sites that the teacher has previewed and deemed of value for the particular type of inquiry in which the students are engaged.

THE INTERNET LESSON PLAN

Lesson Title	Lesson Plan Type
Content Subjects and Grade Level	Description
Objectives (The students will be able to):	Educational Goals

Materials

Internet resources involved (Web sites):
URL:
URL:
URL:
URL:

Other Resources

Procedures & Timelines

Non-Internet Activities	Internet Activities

Problems and Issues that may be encountered

Solutions and Adjustments

Assessment Design

Follow-up Activities & Extensions

Figure 4.6

Search Engines

While the Internet and World Wide Web are global information networks pulsating with vitality, finding the precise bit of information you want can be difficult unless you use a search engine. The Web sometimes seems to be a virtual library of all human knowledge. The range of information on the Web is staggering, and makes finding exactly what you want like looking for a needle in a haystack. Sophisticated search engines, indices, and subject directories like those listed below, however, can make searching the Web much easier.

Search engines fit in to two categories: Full Text Search Service or Directory Search Service. Some engines actually function as both full text search services and directory search services. You should select the type of engine that fits your needs:

Full Text Search Service searches through the full text of a database (normally indexed). You enter search word(s) and get a list of search results. This type of engine suits those occasions where you can think of words related to what you are looking for, but don't know which area they belong to. Some examples of full-text search engines: Alta Vista, WebCrawler, Lycos, HotBot, Excite.

Directory Search Service is a search service whose database is classified according to areas. You narrow down areas little by little, finally pinpointing the target you are looking for. This type of engine suits those occasions when you vaguely can think of themes or areas related to what you are looking for, but don't know the exact words.

Some examples of directory search engines: Yahoo!, Lycos A2Z, Infoseek Guide, Magellan, Web Servers Directory, Web catalog (CERN).

ALTA VISTA

http://altavista.digital.com/

Rapidly becoming a favorite of many Web users due to its super-fast speed and massive database, Digital Equipment Corporation's Alta Vista engine rapidly searches through what may be the largest Web index. Alta Vista stores and retrieves all of the eight billion words it has found during full-text searches of more than thirty million Web pages. It provides a full-text index of more than 13,000 newsgroups and gives extensive help with advanced searches.

ARGUS CLEARINGHOUSE

http://www.clearinghouse.net/

The Clearinghouse, a Web research library at the University of Michigan, is another Internet pioneer, having provided access to Internet information since 1993. Hundreds of topics are available. The Clearinghouse is searchable and browsable, and includes links to other research resources.

EXCITE

http://www.excite.com/

If you can't describe exactly what you're looking for, Excite's "concept" navigation method might be what you are looking for. This Web index is deep, broad, and is updated weekly. Excite's team of expert journalists offer reviews of 55,000 sites. Excite covers Usenet newsgroups. It provides hourly news, commentary, and even an interactive cartoon.

HOTBOT

http://www.hotbot.com/

Hotbot's search engine indexes the entire World Wide Web every week, and has already indexed fifty-four million Web pages. Date, domain or continent can be used to define your searches. Searches can be made for Java, VRML, and Netscape plug-ins.

INFOSEEK

http://guide.infoseek.com/Home?pg=Home.html&sv=N1

Infoseek Guide (originally known as InfoSeek Net Search), another popular Web-search service, presents you with what the engine surmises to be the most relevant matches to your keyword(s) as well as related topics to explore. InfoSeek offers a powerful way to search the Web. Just type a question in plain English or enter words and phrases. The engine searches through its index of the Web, Usenet, and e-mail addresses, and provides list of related categories with search results.

LYCOS

http://a2z.lycos.com/

Lycos is a comprehensive catalog of the Internet that finds what you need including text, graphics, sounds, and videos. It has been called one of the top eleven Internet search engines in quality of information and relevancy of results. The Lycos A2Z directory starts with the most frequently linked sites, and adds concise, authoritative descriptions.

MAGELLAN

http://www.mckinley.com/

Magellan can be searched via twenty-six topics listed on the home page or by a keyword. Magellan's "People Finder" searches for people, businesses, government, and faxes in the U.S. and Canada. "Events Online" is a calendar of live chats, showings, and exhibitions on the Web. "Stellar Sites" is like a travelogue of Web sites covering various different topics.

WEBCRAWLER

http://www.webcrawler.com/

This famous site is a veteran search engine that offers high-speed Web research with a random-links feature to find new and unusual sites.

YAHOO!

http://www.yahoo.com/

The pioneer Internet guide, Yahoo! has been indexing Web content almost from the beginning. Yahoo! Is updated daily, allowing users to browse and search subject categories. In addition to Web searches, Yahoo! also has up-to-the-minute news headlines, weather forecasts, sports scores, and stock quotes.

Exploring cyberspace can be very exciting for both teachers and their students. Surfing the surface of all of the topics found on the Internet does not promote higher level thinking or provide the opportunity for the synthesis of that knowledge or time to reflect upon what has been seen. The OPPORTUNITY FOR ASSESSMENT #12 provides an ordered way for students to journal what they have found in the course of their travels, be critical about the resources sites they have explored, and provide time to meaningfully think about their experience. *Cyber Chronicles* is presented here as an Performance task for middle level students but can be used with secondary students as well. The performance standards (qualities evaluated) on the scoring rubric may be changed to reflect a higher level of expectation for the older students. Elementary students may travel the Information Superhighway but with a bit more restraint and supervision. Teachers should bookmark sites that they have chosen for students to explore and chronicle.

Opportunity for Assessment #12

Cyber Chronicles

Level Middle

Content Standards

Language Arts (descriptive and reflective writings)

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Writes with a command of the grammatical and mechanical conventions of composition
- ☐ Demonstrates competence in general skills and strategies of the reading process
- ☐ Demonstrates an understanding of the nature and function of the English language

Technology

- ☐ Students will use appropriate technologies to create written, visual, oral and multimedia products to communicate ideas, information, or draw conclusions.

Performance Standards

- ☐ Organization and quality of entries
- ☐ Description and detail of entries
- ☐ Writing mechanics
- ☐ Creativity and sophistication of journal presentation

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☐ Bodily/Kinesthetic
- ☐ Interpersonal/Social
- ☑ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Students will work with teachers to select a research topic. While subject research is underway, student is to keep a journal of Internet sites he or she deems of value or interest.

Assessment Technique

Portfolio Evaluation (see Figure 4.7).

QUALITIES OF INTERNET JOURNAL				
Qualities Evaluated	**Advanced**	**Proficient**	**Basic**	**Novice**
Organization and quality of entries	Excellent level of organization and superior and unique entries	Accomplished level of organization and quality of entries	Developing basic level of organization as well as entry quality (uneven)	Beginning level of organization lacking both substantial and relevant entries
Description and detail of entries	Entries contain a superior level of description and detail	Entries display an accomplished level of description detail	Entries display uneven detail description	Entries lack detail in description
Writing mechanics	Excellent writing mechanics (punctuation, grammar, and spelling)	Accomplished level of punctuation, grammar, and spelling	Erratic punctuation, grammar, and spelling	Punctuation, grammar, and spelling of poor quality
Creativity and sophistication of journal presentation	Journal presentation is highly creative and sophisticated	Evidence of creativity in presentation	Some level of creativity observed in journal presentation	Journal presentation lacks creativity or sophistication

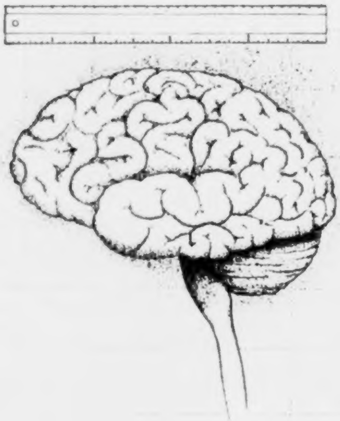
Figure 4.7

The Human Touch

Despite revolutionary advances in the field of educational computing, technology still remains simply a tool. Potentially powerful and stimulating, the computer is merely an inert object that could never be a substitute for the personal touch of the classroom teacher. However, the manner in which teachers implement technology and computer use in their classrooms ultimately will become the critical factor in education's future. Without improving the connection between curriculum content, technology, and school process, technology will be unable to support a child's learning style or various intelligences in the best possible manner. Different learning styles and intelligence types are what make each learner unique.

CHAPTER 5

MULTIPLE INTELLIGENCES AND BRAIN-COMPATIBLE ASSESSMENT



It is of the utmost importance that we recognize and nurture all of the varied human intelligences, and all of the combinations of intelligences. We are all so different largely because we all have different combinations of intelligences. If we recognize this, I think we will have at least a better chance of dealing appropriately with the many problems that we face in the world.—Howard Gardner 1987, 189.

Learning and Intelligence

There is little agreement on a general definition of intelligence, but most persons would agree that it involves, at the least, the ability to learn and apply what has been learned. In addition, it is the ability to adapt to one's environment, or to modify that environment, or seek out and create new environments.

The concept of intelligence as something that could be quantified originated in France with the pioneering work of Alfred Binet and Theodore Simon. The two men published the Binet-Simon test of the mental ability of children in 1905, popularizing their theory that intelligence was tangible and could be objectively measured. Nearly two decades later, American, Lewis Madison Terman coined the term *intelligence quotient* ("IQ") and applied a normative scale to Binet and Simon's test. The resultant Stanford-Binet test has become one of the most widely used intelligence tests in the world. It is clear, however that there is little correlation between IQ and what a person is able to learn and do in the real world. Many cognitive researchers are proving that intelligence is, in fact, an open, dynamic system, modifiable at any age and ability level.

Multiple Intelligence Theory

Almost eighty years after the first intelligence tests were developed; Harvard psychologist, Howard Gardner challenged what had become commonly held beliefs about the nature of intelligence. In his book, *Frames of Mind* (1983), he asserted that Binet and those that had built upon his work had defined intelligence too narrowly, and that there exists many different kinds of intelligences. With his theory of Multiple Intelligences (MI theory), Gardner sought to broaden the prevailing view of human potential beyond the confines of the IQ score. He contended that intelligence had more to do with one's capacity for solving problems and creating products in a real world setting than the IQ concept recognized.

Gardner provided a means of mapping the broad range of human abilities by grouping their capabilities into eight comprehensive categories or "intelligences" each considered equally important.

Visual/Spatial Intelligence is the ability to perceive the visual-spatial world accurately, and to act upon those perceptions. This intelligence involves an awareness of color, line, shape, form, space, as well as the relationship that exists between these elements.

Logical/Mathematical Intelligence refers to acuity with numbers and the capacity to reason effectively. This intelligence includes the awareness of logical patterns and relationships, functions, and other related abstractions.

Verbal/Linguistic Intelligence is the capacity to use words effectively, whether orally or in writing. This intelligence includes the ability to handle syntax (language structure) as well as phonology (sounds) and semantics (meaning).

Musical/Rhythmic Intelligence is the capacity to perceive, discriminate, transform, and express musical forms. This intelligence includes sensitivity to rhythm, melody, and timbre of a musical piece.

Bodily/Kinesthetic Intelligence is the ability to use one's whole body to express ideas and feelings, and the facility to use one's hands to produce or transform things. This includes the physical skills of coordination, balance, dexterity, strength, flexibility, and speed.

Interpersonal/Social Intelligence is the ability to perceive and discern between the different intentions, motivations, and feelings of other people. This can involve sensitivity to facial expression, voice, and gesture, as well as the capacity for discriminating among an assortment of interpersonal cues, and the ability to respond effectively to those cues.

Intrapersonal/Introspective Intelligence is the capacity for self-awareness and self-knowledge as well as the ability to adapt oneself using that knowledge. This involves having an accurate and realistic image of oneself (strengths as well as limitations); an awareness of one's inner moods, intentions, motivations, temperaments, and desires; and the capacity for self-discipline, self-understanding, and self-esteem.

Naturalist Intelligence is the ability to make distinctions and form classes among objects (as in nature and the environment). The core of this kind of intelligence is the human ability to recognize plants, animals, and other parts of the natural environment. While this intelligence doubtless evolved as a means for humans dealing with their natural surroundings, it has been further evolved (or has been co-opted) to include the ability to distinguish between and recognize man-made objects such as cars, sneakers, and jewelry.

GARDNER'S EIGHT INTELLIGENCES

Visual/Spatial

Images, graphics, drawings, sketches, maps, charts, doodles, pictures, spatial orientation, puzzles, designs, looks, appeal, mind's eye, imagination, visualization, dreams, nightmares, films, and videos.

Logical/Mathematical

Reasoning, deductive and inductive logic, facts, data, information, spreadsheets, databases, sequencing, ranking, organizing, analyzing, proofs, conclusions, judging, evaluations, and assessments.

Verbal/Linguistic

Words, wordsmiths, speaking, writing, listening, reading, papers, essays, poems, plays, narratives, lyrics, spelling, grammar, foreign languages, memos, bulletins, newsletters, newspapers, e-mail, FAXes, speeches, talks, dialogues, and debates.

Musical/Rhythmic

Music, rhythm, beat, melody, tunes, allegro, pacing, timbre, tenor, soprano, opera, baritone, symphony, choir, chorus, madrigals, rap, rock, rhythm and blues, jazz, classical, folk, ads, and jingles.

Bodily/Kinesthetic

Art, activity, action, experiental, hands-on, experiments, try, do, perform, play, drama, sports, throw, toss, catch, jump, twist, twirl, assemble, disassemble, form, re-form, manipulate, touch, feel, immerse, and participate.

Interpersonal/Social

Interact, communicate, converse, share, understand, empathize, sympathize, reach out, care, talk whisper, laugh, cry, shudder, socialize, meet, greet, lead, follow, gangs, clubs, charisma, crowds, gatherings, and twosomes.

Intrapersonal/Introspective

Self, solitude, meditate, think, create, brood, reflect, envision, journal, self-assess, set goals, plot, plan, dream, write, fiction, nonfiction, poetry, affirmations, lyrics, songs, screenplays, commentaries, introspection, and inspection.

Naturalist

Nature, natural, environment, listen, watch, observe, classify, categorize, discern patterns, appreciate, hike, climb, fish, hunt, snorkle, dive, photograph, trees, leaves, animals, living things, flora, fauna, ecosystem, sky, grass, mountains, lakes, and rivers.

Figure 5.1 Adapted from *Problem-Based Learning and Other Curriculum Models for the Multiple Intelligences Classroom*, by Robin Fogarty. © 1997 by SkyLight Training and Publishing, Inc. Reprinted with permission of SkyLight Professional Development, Arlington Heights, IL.

(*Existential Intelligence*, which refers to the human proclivity to ask fundamental questions, such as "What is the meaning of life?", has been a candidate for several years, but Gardner has not yet included it on the list.)

Gardner contends that school systems tend to teach, test, reinforce, and reward verbal/linguistic and logical/mathematical abilities over the others. Recognizing the efficacy of each of the intellingences is central to brain-compatible instruction. It's logical then that persons having different intelligences enjoy and excel at different types of activities. Figure 5.1 "Gardner's Eight Intelligences" outlines the various activities associated with the different intelligences.

Any time students are given the opportunity to work on a project that interests them and that recognizes more than just verbal/linguistic and logical/mathematical intelligences, they will be better able to recall newly introduced information during related events in the real world. The following OPPORUNTITY FOR ASSESSMENT allows students to demonstrate their understanding of the plot of a story by visually depicting the story line. *Fairy Tale Storyboard* is an elementary level activity that can be easily adapted to other level classrooms. Middle and secondary level students can make a storyboard showing a lengthy story or novel. Students studying a foreign language can create their storyboards as evidence of understanding of a story or fairy tale in another language. The storyboard idea also works when studying many social studies topics because it shows a sequential progression of events.

Opportunity for Assessment #13

Fairy Tale Storyboard

Level Elementary

Content Standards

Language Arts

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Demonstrates competence in the general skills and strategies of the reading process
- ☐ Demonstrates competence in the general skills and strategies for reading literature.

Visual Arts

- ☐ Knows how to use the structures and functions of art
- ☐ Understands the characteristics and merits of one's own artwork and the artwork of others

Performance Standards

- ☐ Depiction of the story's plot
- ☐ Creativity
- ☐ Clarity and neatness
- ☐ Teamwork

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance task

Working in small groups, students will create storyboards depicting the events of a fairy tale.

Assessment Technique

Portfolio Assessment, which allows for extended product revision and development (see Figure 5.2).

STORYBOARD PORTFOLIO EVALUATION RUBRIC				
Qualities Evaluated	**Advanced** ***Work quality is excellent and sophisticated***	**Proficient** ***Work quality is accomplished***	**Basic** ***Work quality shows developing skill***	**Novice** ***Beginning-level work quality***
Depiction of the story's plot	Depicts rising action, climax, and falling action accurately and sequentially	Action is depicted accurately and sequentially	Depicts most events accurately	Does not depict the plot accurately or sequentially
Creativity	Renders all events in a highly unique, creative, and innovative manner	Creative rendering	Shows some creativity	Lacks creativity
Clarity and neatness	Is informative, entertaining, and easily understood	Is neat, clear, and easily understood	Generally understandable	Unclear and confusing
Teamwork	Group members clearly demonstrate their ability to be constructive members—helping others as well as asking for help when needed	Group members worked constructively with each other	Team members worked well together sporadically	No evidence of constructive teamwork

Figure 5.2

Motivation

Most learning style theories focus on the process used to initiate the learning. Behaviorism employs an extrinsic motivation system of rewards and punishments to cause learning to occur. Multiple intelligences (MI) theory, on the other hand, is cognitive rather than behavioral because it works using innate and intrinsic motivation and is therefore brain-compatible.

The Cognitive Model

MI theory, unlike other current learning style theories, is a cognitive model in that it seeks to describe how individuals use their different intelligences to solve problems and create products. Unlike other models that are primarily process oriented, the MI approach is geared to how the human mind operates on the contents of the world (objects and people). The theory

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suggests that most people can develop all their intelligences to a relatively competent level of mastery. Whether or not these intelligences actually develop to their full potential depends on the three factors. These factors are biological endowment (hereditary factors as well as traumas or injuries to the brain), personal life history (experiences with parents, teachers, peers, and others), and the cultural and historical background of an individual (the time and place in which the individual was born and raised).

Consequences for brain compatibility: For strong development of all the intelligences, teachers must not allow any of them to be neglected. By recognizing multiple intelligences, teachers develop student strengths rather than accentuate student weaknesses.

The Personal Development Model

MI theory helps educators understand how their own personal learning style (their acute intelligences) affects their classroom teaching style. It is useful in helping teachers become cognizant of their own shortcomings, and realize that every individual has the power to activate underdeveloped or paralyzed intelligences.

One of MI theory's greatest contributions to education is that, like brain-compatible learning and assessment, it presents the case for teachers to expand their repertoire of techniques, tools, and strategies beyond the traditional verbal and mathematical. MI theory emphasizes the importance of an individual constructing his or her own understandings in a way that is personally meaningful (National Council of Teachers of Mathematics Statement 1998).

Consequences for brain compatibility: In a brain-compatible classroom instruction and assessment utilize a multiple intelligences approach. The students are provided with a wide variety of topics, instructional methods, and presentation and assessment styles, which enable them to construct their own meaningful learning and encourage the evolution of sophisticated levels of understanding. To achieve greater comprehension, students need opportunities to discuss and debate unfamiliar concepts and ideas. They need to be able to test their understandings and participate in the higher cognitive levels of thinking that accompany such active dialogue. It is through such discussion and debate that shared meanings are developed and advanced. It is also the way in which meaningful learning becomes internalized and thus personalized. Without participatory dialogue, learning remains outside the person, removed from that person's experiences and mental connections. Where no personal connections are possible, learning continues to be elusive and difficult to retain.

The Alternative Educational Model

Many contemporary alternative educational models are essentially brain-compatible multiple-intelligence systems using different terminologies (and with varying levels of emphasis upon the different intelligences). Cooperative learning, for example, places its greatest emphasis on interpersonal intelligence, yet specific activities within the cooperative learning format can involve students in each of the other intelligences as well.

Consequences for brain compatibility: In the brain-compatible classroom, the teacher alternates between different methods of presentation often combining different intelligences as well as providing numerous hands-on experiences and activities. The brain-compatible educator also encourages students to interact with each other in different ways (pairs, small groups, large groups). Since students have varying levels of ability in the different intelligences, any single teaching strategy could succeed with one group of students, yet not be as effective with another. Because each student's brain is unique, no single set of teaching strategies will work best for all students at all times. Because of these individual differences, the most effective teachers are those who are able to use a broad range of teaching strategies with their students.

Beyond the Blackboard

Simply put, MI theory as well as brain-compatible instruction and assessment encompass all the methodologies that good teachers have always used in their teaching and evaluating. They reach beyond the textbook and blackboard to encourage student creativity, interest, and intelligence. Brain-research and MI theory provide a way for all teachers to reflect upon their best teaching methods, and to understand why these methods work. They also help teachers expand their current teaching style and assessment repertoire to include a broader range of methods, materials, and techniques for reaching an even wider and more diverse range of learners.

Multiple Intelligence Theory, by implication, calls for the implementation of brain-compatible learning because…

- it provides variety and stimulation.
- the students create products using their own interests and skills.
- the pair learning model (or pair and share model, which harnesses the dynamic energy when two individuals interact) allows for individualized learning plans that are developed according to each student's learning style, assorted intelligences, strengths, interests, and needs.
- the teacher acts as a resource, facilitator, coach, and guide.

The OPPORTUNITY FOR ASSESSMENT # 14 demonstrates how MI theory and brain compatible learning work especially well together. Students are presented with an authentic and open-ended problem, asked to work in cooperation with others, and can use their own interests and intelligences to resolve the problem. *Invitation to Invention* is a secondary activity that, like all of the tasks presented in this book, is easily adapted to other levels. Inviting elementary and middle grade students to create a life-improving invention can yield wonderful results. Younger students become acquainted with the process of scientific inquiry and many different ways to look at a problem. Teacher expectations at any level should be provided to students as they begin an activity so that they know in advance what "excellence" looks like.

Opportunity for Assessment
#14

Invitation to Invention

Level Secondary

Content Standards

Science

☐ Understands the science enterprise
☐ Understands the nature of technological design
☐ Understands the interactions of science, technology, and society

Technology

☐ Understands the impact that technology has on the social, cultural, and environmental aspects of life
☐ Recognizes technology as the result of a creative act and will be able to apply disciplined problem-solving strategies to create written, visual, oral, and multimedia products to communicate ideas, information, or conclusions

Mathematics

☐ Effectively uses a variety of strategies in the problem-solving process

Language arts (scientific and reflective writing)

☐ Demonstrates competence in the general skill and strategies of the writing process
☐ Demonstrates competence in the general skill and strategies of the reading process

Performance Standards

☐ Planning
☐ Observing
☐ Drawing Inferences
☐ Synthesizing Information

Multiple Intelligence Learning Styles

☑ Visual/Spatial
☑ Logical/Mathematical
☑ Verbal/Linguistic
☐ Musical/Rhythmic
☑ Bodily/Kinesthetic
☑ Interpersonal/Social
☑ Intrapersonal/Introspective
☑ Naturalist

Performance Task

Students work in pairs using the Internet as a main research source to design and/or construct a machine, a process, or a theory that will improve an aspect of everyday life.

Assessment Technique

Student Self-Assessment and Scoring Rubric (see Figures 5.3 and 5.4).

Invitation to Invention
Student Self-Assessment

Name:_______________________________ Date:_____________

How to grade the project

Was the invention/process successful?
Were the scientific investigations carried out and recorded accurately?
Was the invention/process well thought out, planned, and executed?
Were all observations accurately recorded?
Were correct inferences drawn?
Did information synthesis take place?

How to grade the effort

Superior: (E)
___My work was superior/excellent
___I made many positive contributions to the effort in every way possible
___I encouraged and assisted my partner when help was needed
___I was key to our success

Satisfactory: (S)
___My work was complete and correct
___I made several positive contributions to the effort
___I encouraged and assisted my partner at least once
___I helped our team succeed

Unsatisfactory: (U)
___I could have done better
___I did not help or encourage my partner
___I did not worry about the project
___I kind of goofed off

Explain the reasons for the grades you gave yourself below.

Figure 5.3

SCIENTIFIC METHOD SCORING CRITERIA

Qualities Evaluated	**Advanced** *Excellent and sophisticated work quality*	**Proficient** *Accomplished level of work quality*	**Basic** *Work quality shows developing skill*	**Novice** *Beginning-level work quality*
Were valid questions clearly stated and tested?	Always	Most times	Sometimes	Not at all
Was the inquiry/ discovery method employed?	Always	Most times	Sometimes	Not at all
Were all observations recorded accurately and concisely?	Observations, recordings, inferences, and synthesis of information is of superior quality	Quality of observations, recordings, inferences, and information synthesis is competent	Quality of observations, recordings, inferences, and information synthesis is inconsistent	Observation, recordings, inferences, and the synthesis of information are imprecise or specious
Was technology used in an appropriate manner for the investigation?	Technology has been and integral part of the entire process	Technology is used competently	Technology is used with some degree of competence	Technology was either not used at all or not used appropriate to the task

Figure 5.4

Message Confusion

Multiple Intelligence theory begs educators to use "naturalistic sources of information about how people around the world develop skills important to their way of life" (Gardner 1987). It is not that standardized tests don't assess multiple intelligences, it is that they do so out of context. And it is precisely the learning and measuring of concepts in context that brings about the desired effect of students creating their own meaning in the context of their individual brain design.

Changes must be made in the assessment methods and techniques currently being used to evaluate learning. To have students learn via strategies grounded in MI and brain-compatible methodologies only to then have them

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demonstrate their learning through narrowly focused standardized or unit tests, is totally self-defeating. Educators are sending a dual message to students and the community that while learning through the use of the assorted intelligences is fun, novel, and exciting, when it comes down to what is really important, knowledge must be quantified and qualified in the traditional manner, by testing. If tests emphasizing the memorization of isolated bits and pieces of information are considered to be the only valid method of assessment, students and parents alike will be given the incorrect impression that knowledge has no connection with or relevancy to the real world outside the classroom.

Brain-compatible MI instruction requires a fundamental restructuring in the way educators evaluate student learning by requiring an "authentic" system of assessments such as those described in chapter 3. Authentic measures enable students to demonstrate what they've learned in context, in a setting that closely matches the environment in which they would be expected to use that learning in real life. Standardized instruments, on the other hand, almost always assess students in artificial settings, removed from any real-world context.

Student Strengths

The shift towards cognitive psychology and brain-compatible learning has educators increasingly interested in helping students develop and learn the use of thinking strategies. How students think has become as important as what they think about. Both brain-compatible and MI instruction and assessments provide the educational community with a language that speaks to the strengths and inner gifts of all students, not only those who happen to learn in either the verbal/linguistic or logical/mathematical mode.

A new curriculum model has been long overdue, one with a new emphasis. Such a curriculum design would be capable of speaking to all learners, each in their own particular brain language. Brain-compatible MI learning provides the tools to do just that.

Group work is one of the best ways for students to exercise their many intelligences. The team approach to problem solving emphasizes interpersonal intelligence, which is the main ingredient to success in the "real world." The OPPORTUNITY FOR ASSESSMENT uses consumer economics to challenge students to use every member of the group and each of their intelligences to resolve an authentic problem. *Auto Economics* is a middle level activity that can be tailored to suit other levels. Elementary students can investigate the price of candy. (What is the price of the candy per piece bought in a bag? Or how many pieces can you buy with a dollar?) Secondary students can sell products of their own devising and track profit, loss, and cost to produce on computerized spreadsheet programs.

Opportunity for Assessment #15

Auto Economics

Level Middle

Content Standards

Mathematics (consumer math)

- ☐ Effectively uses a variety of strategies in the problem solving process
- ☐ Understands and applies basic and advanced properties of the concepts of numbers
- ☐ Understands and applies basic and advanced properties of data analysis and distributions

Social Studies (economics)

- ☐ Understands that the scarcity of productive resources requires choices that generate opportunity costs
- ☐ Understands the concept of prices and the interaction of supply and demand in a market economy

Language Arts (descriptive and reflective writing)

- ☐ Writes with a command of the grammatical and mechanical conventions of composition
- ☐ Demonstrates competence in speaking and listening as tools for learning

Performance Standards

- ☐ Presentation
- ☐ Construction and Use of Visual Aids
- ☐ Teamwork

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☑ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

Students, in groups of four, will compare and contrast new car data. Each team member will select his or her own auto for purchase based on data comparisons. Members will then research payment options such as purchasing the car with a loan from a bank, using the dealership as a finance source, or leasing. Groups will make a presentation (e.g., written reports, graphs, charts) to the class comparing their different car and finance choices, as well as their conclusions.

Assessment Technique

Performance Assessment consisting of informal observations by the teacher and peer evaluation (Figure 5.5).

AUTO ECONOMICS PRESENTATION RUBRIC

Qualities Evaluated	**Advanced** *Excellent and sophisticated work quality*	**Proficient** *Accomplished level of work*	**Basic** *Work quality shows developing skill*	**Novice** *Beginning-level work quality*
Presentation	Presentation was well organized, clear, concise, entertaining, and easily understood	Presentation was organized and easily understood	Portions of presentation were difficult to understand; some organization evident	Presentation was unclear and difficult to understand
Construction and use of visual aides	Visual aids were appropriate, creative, aesthetically pleasing, and easily understood	Visual aids were appropriate and clear	Visual aids were not entirely clear or illustrative	Visual aids were inappropriate and/or difficult to understand
Teamwork	All members participated fully	All members participated	Most members participated	Little participation by members

Figure 5.5

CHAPTER 6

COLLABORATIVE LEARNING

Working in small groups provides students with opportunities to talk about ideas and listen to their peers, enables teachers to interact more closely with students, takes positive advantage of the social characteristics of the [student], and provides opportunities for students to exchange ideas and hence develop their ability to communicate and reason.
—National Council of Teachers of Mathematics, 1989, 87

The Benefits of Cooperation

One of the best instructional strategies for brain-compatible and MI learning is the cooperative or collaborative model for learning. *Cooperative and collaborative learning* is a method of instruction whereby small groups of students of varying ability levels use a wide-range of activities to acquire higher-order thinking skills. Dozens of major studies have concluded that the use of cooperative learning strategies can result in "positive student achievement, improved relations among different ethnic groups, and mainstreaming students with learning disabilities" among other benefits (Balkcom 1992). In addition, cooperative learning is inexpensive when compared to other educational initiatives and easy to implement.

New Understandings

Brain research and neuroscience have added to the collective understanding of how the brain learns, or doesn't learn, and why. Educators are beginning to gain a scientific understanding of the learning process, and from that understanding, they can make better decisions about how to structure learning environments and instructional practices.

As a result of this greater understanding, educational leaders have made some of the following learning strategy recommendations that would help to promote a more brain-compatible style of teaching and learning in schools:

1. Provide variety and stimulation for students through the use of project units, field trips, speakers, varied as well as different media.
2. Have students actively create products, make presentations or exhibitions using their interests as a springboard for the project concepts.
3. Use the teacher as a facilitator, coach, arranger, expediter or stage manager. (Holt 1993, Caine and Caine 1994)

Current brain research has resulted in new levels of knowledge and insight regarding teaching and learning, which appear to stress the following five factors:

- Students learn in a variety of different ways.
- Students do best when they actively participate in the learning.

- Students need to make connections not only intellectually, but also physically and emotionally with the topics they are studying.
- Feedback between the student and the teacher helps to fine tune the brain's patterns and programs.
- For maximum learning to occur, students must feel safe and secure.

The following OPPORTUNITY FOR ASSESSMENT recognizes the need for students to formulate patterns of understanding by fitting them into the context of what they already know. It uses a familiar object (a kite) to bring about understanding of a new concept (two-dimensional geometric forms). *Kites for Everyone!* Is an elementary activity but can be changed to accommodate learners at other levels. Middle level students may be asked to construct a three-dimensional box-type kite, while secondary student projects may focus on the aerodynamic properties of their kites. The method of evaluation may be changed to best gain perspective on student growth and understanding.

Opportunity for Assessment #16

Kites for Everyone!

Level Elementary

Content Standards

Mathematics

- ☐ Effectively uses a variety of strategies in the problem solving process
- ☐ Understands and applies basic concepts of geometry
- ☐ Understands the general uses and nature of mathematics

Language Arts

- ☐ Demonstrates competence in the general skills and strategies of the writing process
- ☐ Writes with a command of the grammatical and mechanical conventions of composition

Visual Arts

- ☐ Knows how to use the structures (e.g., sensory qualities, organizational principles, expressive features) and functions of art
- ☐ Understands the characteristics and merits of one's own artwork and the artwork of others

Performance Standards

- ☐ Kite construction
- ☐ Neatness
- ☐ Originality
- ☐ Ability to construct a math sentence

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☑ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☐ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☑ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

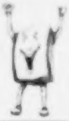
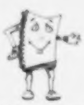
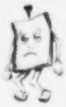
In pairs, students work together using pattern blocks and design templates to experiment with various tessellation possibilities for kite design. The students then write one sentence that describes the shapes they used in their kite design and their relative placement.

Assessment Technique

Student Self-Assessment Outline helps in the development of self-directed learning skills (see Figure 6.1).

KITES FOR EVERYONE!
Elementary Self-Assessment

1. Do all my geometric shapes fit together with no empty spaces?

2. Is my kite neat and original?

3. Does my math sentence tell something about my kite and the shapes inside?

4. Does my geometric shape design fill up the whole kite shape?

5. Can I make a kite shape-design and write a sentence about it by myself now?

Figure 6.1

The Spectrum of Interdependence

Cooperative learning fosters the development of independence in learners since it puts them, instead of their teacher, in charge of their own learning. The students are thus encouraged to gauge whether what they are doing is at the expected level of quality. The teacher, acting only as a guide, takes a back seat to the learners while they grow and become more self-sufficient, self-reliant, and competent in their expectations for themselves.

In other words, cooperative education fosters brain-compatible learning in the following ways:

1. Learners must feel safe and secure before any learning can occur. Therefore it is incumbant upon the school to foster a feeling of security. Because complex learning is enhanced by challenge and inhibited by threat, the learning environment in the classroom must represent low stress and at the same time high challenge. (See chapter 1, the “Emotions in Context” section.)
2. The brain is social, allowing learning to thrive in group situations.
3. The search for meaning is innate; therefore, problem-solving situations allow the brain to make use of this innate search for meaning.
4. Since the brain searches for meaning through patterning and emotions are critical to patterning, the more a learner is emotionally and socially involved in his or her work, the more learning is retained for future application.
5. Group work favors brain-compatible learning because the brain simultaneously perceives and creates parts and wholes. In group work, a project can be dealt with as an entity while at the same time individual contributions that make up that entity are recognized.

The Spectrum of Interdependence (see Figure 6.2) shows the range of consequences of positive and negative interdependence.

The Competitive Classroom

Most competitive classroom situations are not conducive to learning for all students because each student must compete with his or her classmates to achieve a goal that only a few can attain. Such an environment feeds the perception that students are in a race against each other. Individual achieve-

SPECTRUM OF INTERDEPENDENCE

Norm-Referenced
(Curve Based)

Criterion-Referenced
(Standards Based)

Goal Attainment for a Select Few

INTERDEPENDENCE

Mutual Goal Attainment

Competitive

Cooperative

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Figure 6.2

ment is gained only at the expense of peers (Johnson and Johnson, 1987). *Negative interdependence*, mutual reliance that has become counter-productive and sometimes even destructive to the learning process, often results. Students try to secure an outcome that is beneficial to them while at the same time necessarily detrimental to those with whom they are competitively linked. A test graded on a curve breeds negative interdependence because a student who gets a very high score can "ruin the curve" for the rest of the group. By having more scores in the higher numbers, the normal curve is bumped up on the higher axis, making the passing grade higher, thereby causing more students to fail though their test performance may not have been "bad." (See Figure 2.2 "Normal Distribution Curve.")

The Individually Structured Classroom

In the individually structured environment, students work by themselves to accomplish learning goals that are unrelated to the performance of other students. Goals are assigned, and student efforts are evaluated against a fixed set of standards with rewards given accordingly. Students work at their own pace, ignoring the other students in the class. In individualistic learning activities, students understand that their achievements are not related to what the other students do. In this modality, students will seek an outcome that is personally beneficial and will see the goal achievements of others as irrelevant. Special education classes are often designed for the individual. These students usually do not take the same standardized tests as the other students, and also do not have time limits when they are being tested. While such a learning environment might seem brain compatible on the surface, it does not afford students the benefit of seeing what the other students are doing or in any other constructive way interacting with them. Because the students are more isolated (in daily classroom work and in testing situations), they will not be sufficiently prepared for real-world survival.

The Cooperative Classroom

A cooperatively structured classroom involves students in ways that necessitate their working together for *mutual* goal accomplishment. Students in small groups are assigned information and/or materials for which *all* the group members are responsible. (They "sink or swim" together.) In a cooperative learning situation there is a *positive interdependence* among the students. The learning goals can only be reached when and if *all* the group members succeed. The students, therefore, seek outcomes that are beneficial to all those with whom they are working. In order for this to occur, they need to discuss the information and/or material with each other, help one another understand it, and encourage each other to work hard.

According to David Johnson, Roger Johnson, and E.J. Holubec (1988), successful implementation of cooperative learning must involve five basic elements: 1. positive interdependence, 2.) face-to-face interaction, 3.) individual accountability, 4.) interpersonal and small group skills, and 5.) group processing.

To achieve the first element of *positive interdependence* mutual goals must first be established (goal interdependence). There must be a division of labor among the group members (task interdependence); division of materials, resources, or information among group members (resource interdependence); assignment of specific jobs or roles to each group member (role interdependence); and the giving of joint rewards (reward interdependence). The Cooperatively Structured Classroom (see Figure 6.3) illustrates how interdependence is at the center of cooperative learning.

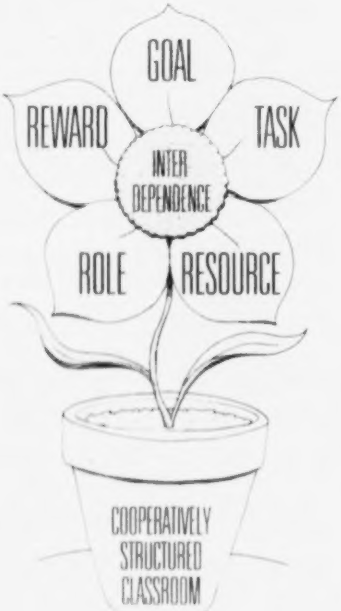

Figure 6.3

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The second element, *face-to-face interaction* occurs when positive educational outcomes result from the positive interaction patterns and verbal exchanges taking place among students in carefully structured cooperative groups. Verbal summaries, giving and receiving explanations, and elaborations (relating the new learning to previous learning) are each important aspects of verbal exchange. In addition, verbal discourse helps to create individual sense making.

The third element, *individual accountability,* refers to the fact that cooperative learning groups will not succeed unless every member has learned the information and/or material, or has helped with and understands the assignment. For this reason, it is essential that the teachers frequently *stress and assess* individual progress so team members can support and help each other.

Because students rarely come to school with the social skills necessary for effective collaboration, instruction in the fourth element, *interpersonal and small group skills* often falls to the teacher. It is up to the teacher to instruct the students in appropriate communication, leadership, trust, decision-making, and conflict management skills as well as provide the motivation to use these skills to ensure effective group dynamics. Humans are not born instinctively knowing how to cooperate with others. Learning how to interact with others is just like learning other basic skills.

The fifth and final element for the successful implementation of cooperative learning is that of *group processing.* Processing is the concept of giving students the time and the procedural skills necessary to analyze how well their groups are functioning and how well they are utilizing the required social skills. Processing, when done correctly, provides accurate, non-threatening feedback to the group regarding the procedures it is using to achieve the intended outcome. Feedback gives group members information that helps them improve performance while maintaining effective working relationships among members.

One way to energize group work is to infuse it with a performance component. The following OPPORTUNITY FOR ASSESSMENT is one that is particularly well suited to strengthening the group dynamic. *Photosynthesis Rap* presents students with the challenge of creating a song that will dramatize the process of photosynthesis. Students must possess an in-depth knowledge of the photosynthesis process before they can accurately and entertainingly present it to their classmates who will be evaluating the performance.

The Performance task can be modified to accommodate elementary classes by requiring only movement and not words or focusing on a content standard appropriate to that level. Secondary classes may be asked to portray more complex processes or give a series of performances. In any case, the task is authentic and provides for a real audience for the performance. Videotaping allows students to critique their own performance from a different perspective, tapes can be made part of a group portfolio or can be shown at parents' night or to students in lower grades as instructional material.

Opportunity for Assessment #17

Photosynthesis Rap

Level Middle

Content Standards

Science (life science)

- ☐ Understands the cycling of matter and the flow of energy through the living environment

Music

- ☐ Composes and arranges music within specified guidelines
- ☐ Improvises melodies, variations, and accompaniments

Language Arts

- ☐ Demonstrates competence in speaking and listening as tools for learning.
- ☐ Demonstrates an understanding of the nature and function of the English language

Physical Education

- ☐ Uses a variety of basic and advanced movement forms

Performance Standards

- ☐ Process was presented accurately
- ☐ Song made sense both scientifically and musically
- ☐ Creativity and originality of thought
- ☐ Movement related to photosynthesis process as well as the music/beat.
- ☐ Teamwork

Multiple Intelligence Learning Styles

- ☑ Visual/Spatial
- ☐ Logical/Mathematical
- ☑ Verbal/Linguistic
- ☑ Musical/Rhythmic
- ☑ Bodily/Kinesthetic
- ☑ Interpersonal/Social
- ☐ Intrapersonal/Introspective
- ☐ Naturalist

Performance Task

In teams of four, students will create a rap song with accompanying movements that depicts the process of photosynthesis.

Assessment Technique

Performance Assessment—informal observation by the teacher as well as peer evaluation (see Figure 6.4).

PRESENTATION EVALUATION RUBRIC				
Qualities Evaluated	**Advanced** ***Excellent and sophisticated performance quality***	**Proficient** ***Accomplished performance quality***	**Basic** ***Developing performance quality (partially acceptable)***	**Novice** ***Beginning-level performance quality (inadequate)***
Process of photosynthesis was presented accurately	Photosynthesis was represented clearly, accurately, and in an entertaining manner	Photosynthesis was presented accurately	Photosynthesis was represented with some accuracy	Photosynthesis process was not accurately presented
Song made sense both scientifically and musically	Words to song made sense from a musical and scientific stand point	Song clearly made sense scientifically	Song made sense scientifically	Song did not make sense scientifically
Content displayed creativity and originality of thought	Rap was highly creative and original	Content displayed creativity	Some creativity was evident	No originality or creativity was displayed
Movement related to photosynthesis process as well as the music/beat	Movements were clever and imaginative in the way they presented the photosynthesis process	Movements reflected the photosynthesis process	Movements, at time seem to suggest the process	Movements irrelevant to the process of photosynthesis
Teamwork	Team worked exceptionally well together	Team worked as a group	Team worked as a group at times	Team did not work as a group

Figure 6.4

The Cooperative Learning Environment

Group Investigations (GI) cooperative learning strategy is structured to emphasize critical and higher order thinking skills. It can be modified to suit any grade level and does not require a curriculum overhaul to implement. It is highly brain compatible because the students actively construct their own learning through their own research. In this manner, each student's brain organizes the new information in its own way, a way that is meaningful to that individual. Most of the OPPORTUNITIES FOR ASSESSMENT presented in this book are group investigations.

Jigsaw II is another recognized cooperative learning format in which each member of a team is responsible for learning a specific part of a topic, and then presenting their part to the rest of their group. This is *not* a good example of a brain-compatible learning format because the learning is fragmented and taken out of a natural context, making it very difficult for the brain to create any meaningful connections. *STAD* (Student Teams-Achievement Divisions) is a form of peer tutoring, where students of varying academic abilities form study groups comprised of four or five members. The teams study the material initially presented by the teacher, and in this manner they are able to help each other learn. Although there is cooperation, there is no actual construction of knowledge by the individual team members themselves.

Educators often believe they are using cooperative learning while in reality they are missing its essence. There is a critical difference between simply putting students into groups to learn and in structuring cooperative interdependence among students. Having students side-by-side at the same table talk with each other as they do their individual assignments is not cooperative learning although such an activity does have a place in the classroom. Cooperative learning is *not* assigning a report to a group of students and letting one student do all the work with the others putting their names on the end product. Cooperative learning *is* the instructional use of small structured groups where students work *together* to maximize their individual learning and that of each member of the group.

The Teacher's Role

The teacher must develop an effective environment and pedagogy that are conducive to learning. Forming effective cooperative student groups, using lessons that require team problem solving, and developing methods to monitor both group work and individual learning are each the teacher's responsibility. In addition, it is the teacher who assigns the actual task to be completed cooperatively, providing assistance to the group or individuals when needed. As facilitator and coach, it is also the teacher who must monitor the functioning of the learning groups and teach those social skills necessary for successful learner collaboration.

Students' Roles

Collaborative learning encourages students to look to their peers rather than the teacher for assistance, feedback, reinforcement, and support. They are expected to share materials, interact, and encourage each other. In order to support individual student accountability, specific roles can be assigned to each member of the group. As students begin their group work, members learn how the roles function with the task at hand. Assigned roles create positive interdependence and teach students new skills. To support individual student accountability, it is beneficial to assign specific roles to each of the group members. Each group member should spend some time in each of the assigned roles. With experience, students will learn easily to shift from role to role.

Cooperative Group Activity Role Assignments

Group Coordinator

- Takes part in and contributes to the group activity
- Gets the group settled down and started on the activity
- Directs the activity and keeps all group members on task
- Encourages all members to contribute to discussions
- Helps group members to agree on answers to questions
- Reminds members to keep voices low during discussions

Group Recorder

- Takes part in and contributes to the group activity
- Keeps notes on all activities for group log entries (see Figure 6.5)
- Prepares a copy of the activity log sheet to be turned in to the teacher at the end of the class

Materials Person

- Takes part in and contributes to the group activity
- Picks up and distributes activity log sheets (see Figure 6.5)
- Picks up and distributes manipulatives and/or project supplies in an efficient manner
- Assumes responsibility for the care of manipulatives and/or project supplies
- Collects and turns in manipulatives and/or project supplies

Resource Person

- Takes part in and contributes to the group activity
- Finds additional resource materials when needed
- Decides when help is needed, and then asks the teacher for that help

In cooperative learning situations, students share materials, interact, and encourage each other. They explain the necessary information to one another, and elaborate on the strategies and concepts they need to use. Exchanges between group members promote critical thinking, higher level reasoning, and metacognitive thought. It's the act of explaining what one knows to one's group-mates and the development of essential listening skills that ultimately fosters the understanding of how to apply knowledge and skills to new and different situations.

Cooperative Group Activity Log

Group Members:

Class Section: ____________ Group Name: ______________

Project:

Date	Name	Work Completed

Figure 6.5 Adapted from *Brain-Compatible Mathematics* by Diane Ronis. © 1999 SkyLight Training and Publishing, Inc. Reprinted with permission of SkyLight Professional Development, Arlington Heights, IL.

Assessing Group Learning

Because cooperative learning is group learning, group assessment must also be part of the equation. If the basic elements of cooperative learning are at work, group assessment means forming evaluations based on individual responsibilities performed toward some group end. All group members must be held responsible for their own learning as well as the learning of others, understand the concepts and assignments, demonstrate mastery of the assigned work, provide leadership, and assess the progress of the group. To assess the group and its members fairly, develop a rubric for the group as a whole as well as each individual member.

Conscious Attention

Managing new approaches to teaching and learning requires a deeper understanding of how the brain works as well as an understanding of what motivates and engages people. Evidence seems to suggest that the brain's ability to stay consciously attentive for extended periods of time is not only rare, but also extremely difficult to achieve. The normal human brain cycles with periods of highly focused attention followed by periods of less conscious attention. The brain requires these lower levels of conscious attention to process the learning it has accumulated during the highly focused period. If too much information is given without allowing for enough processing time, the brain cannot perform well and optimal learning will not occur.

Brain-compatible cooperative learning supports the "processing time" concept because the time students discuss, write, work on projects, or peer teach is the time when they are best able to process their learning. In addition, processing allows for student reflection. The ability to reflect upon learning takes cognition a step further, to a level commonly referred to as *metacognition*. Metacognition, or thinking about one's thinking (the ability to self-reflect), is a higher-order cognitive skill.

In order to help students learn to use their metacognitive skills, they must first be instructed in methods of self-reflection. The processes of helping students begin to be self-reflective means guiding the structure of their reflections. Figure 6.6 offers a way to structure student reflections.

Metacognition and self-reflection are means of assessment, while observation is an important means of assessment integration. With observation, the

SAMPLE QUESTIONS TO GUIDE STUDENTS IN REFLECTIVE WRITING

Understanding the Problem Situation

- ☐ Can you tell me about this problem in your own words?
- ☐ Is anything missing, or has any unnecessary information been given?
- ☐ What, if any, assumptions are you making about the problem?

Planning the Strategy

- ☐ Can you explain your strategy to me?
- ☐ What have you tried so far?
- ☐ How did you organize your information?
- ☐ Is there a simpler problem related to this one that you might solve first?

Executing the Strategy

- ☐ Can you show me how you checked your work?
- ☐ Why did you organize your data this way?
- ☐ Why did you draw this diagram?
- ☐ How do you know whether what you are doing is correct? Logical?

Reviewing the Work

- ☐ Are you sure your strategy/solution is correct? Why?
- ☐ Could you have solved this problem differently?
- ☐ What made you decide to use this particular strategy?

Problem-solving Communication

- ☐ Can you reword this problem using simpler terms?
- ☐ Can you explain what you are doing?
- ☐ How would you explain what you are doing to a teammate who is confused?
- ☐ Can you design your own problem using this same strategy?

Problem-solving Connections

- ☐ Have you ever solved a similar problem? How is it the same? How is this different?

Self-Assessment

- ☐ Is this kind of problem-solving easy or difficult for you?
- ☐ What makes this type of problem-solving easy? What makes it difficult?
- ☐ In general, what kind of problem situations are especially hard for you? Which are easy? Why?

Figure 6.6

teacher is able to monitor the learning as it occurs within the group. Performance tasks usually have an audience, in this case the teacher and the rest of the class. By learning what society values, students will be better equipped to self-evaluate.

Activities such as the one presented in OPPORTUNITY FOR ASSESSMENT # 18: have been proven to foster positive interdependence, promote class morale, and improve student attendance. The *Checks and Balances Video* is a cooperative learning opportunity that at the same time recognizes individual strengths and intelligences. In the process of producing the video students will necessarily become intimately familiar with the concept of check and balances or any other subject or concept the teacher assigns. The assessment task is presented here as appropriate to the secondary level, but just about any level (with varying degrees of coaching from the teacher) can learn from creating a video. Elementary students could act out a story or interact as phonemes to create words (or numbers to create math sentences). Middle level students can create videos that dramatize a story or play of their own creation or "television" commercials designed to persuade students to buy the concepts of democracy or the free market system.

Opportunity for Assessment *18

Checks and Balances Video

Level Secondary

Content Standards

Social Studies (civics)

☐ Understands ideas about civic life, politics, and government
☐ Understands the concept of a constitution, the various purposes that constitutions serve, and the conditions that contribute to the establishment and maintenance of constitutional government
☐ Understands the major characteristics of systems of shared powers and of parliamentary systems

Language Arts

☐ Demonstrates competence in the general skills and strategies of the writing process
☐ Writes with command of the grammatical and mechanical conventions of composition

Technology

☐ Safely and effectively use resources, processes, concepts, and tools of technology

Performance Standards

☐ Clarity of purpose
☐ Accuracy of presentation
☐ Creativity and Originality
☐ Communication
☐ Teamwork

Multiple Intelligence Learning Styles

☑ Visual/Spatial
☐ Logical/Mathematical
☑ Verbal/Linguistic
☐ Musical/Rhythmic
☐ Bodily/Kinesthetic
☑ Interpersonal/Social
☑ Intrapersonal/Introspective
☐ Naturalist

Performance Task

Students will work together in groups of three or four, creating a videotape depicting the system of checks and balances in the U.S. government. Students are encouraged to use the Internet as a project research resource.

Assessment Technique

Presentation rubric to be completed by the teacher and the audience/class (see Figure 6.7). And a self-assessment to be completed by individual team members about their own work (see Figure 6.8).

Presentation Rubric for Checks & Balances Video

Part 1: Video Content

Qualities Evaluated

☐ System of checks and balances was presented accurately
☐ Video clearly represented the major characteristics of a shared power system
☐ Extensive research was evident in the finished product
☐ Content of video displayed creativity and originality
☐ Presentation was well articulated and easy to understand
☐ Team functioned synergistically

Were all the objectives for this assignment carried out by the team?

Does the video have a clear goal/purpose?

Is there a rationale to the video?

Is the video engaging and entertaining?

How was the video's goal carried out?

Were visual aides provided? Were they helpful?

How did or didn't the visual aids add to the presentation?

Part 2: Video Organization

☐ Logical, sequential order to presentation
☐ Interesting beginning
☐ Informative middle
☐ Strong conclusion
☐ Well planned (not "off the cuff")

Comments:

Figure 6.7

Self-Assessment

Evaluation Qualities for Checks & Balances Video

How to Grade the Project

Were the required concepts expressed clearly and accurately?
Would a viewer understand the major characteristics of a shared powers system after viewing this video?
Was the video well thought out, planned, and executed?
Was the video informative? Entertaining?

How to Grade the Effort

SUPERIOR: (E)
___My work was superior/excellent
___I made many positive contributions to the effort in every way possible
___I encouraged and assisted my partners when help was needed
___I was key to our success

SATISFACTORY: (S)
___My work was complete and correct
___I made several positive contributions to the effort
___I encouraged and assisted my partners at least once
___I helped my group succeed

UNSATISFACTORY: (U)
___I could have done better
___I not help or encourage my teammates
___I did not worry about the project
___I kind of goofed off

Below, justify the grade you have given yourself.

Figure 6.8

GLOSSARY

assessment. the process of gathering information about students what they know and can do.

Behaviorism. a branch of psychology closely associated with education that espouses the use of reward and punishment to motify behavior.

bell curve (or bell-shaped curve). a symmetrical curve, usually plotting a continuous frequency distribution (tally of the number of times a particular type of event occurs), such as a normal distribution, which looks like a cross section of a bell.

benchmark. a standard used for judging a performance, a benchmark defines the quality level of a student's work.

cognition. the information a student learns, understands, and knows

computer-assisted instruction (CAI). any form of instruction making use of technology and/or computers as a tool for the learning.

content standards. statements about what students should know and be able to do. They describe the knowledge and skills that students should acquire.

curricular objectives. goals or objectives outlined in a curriculum, hopefully, encompassing both content and performance standards.

constructivist learning theory. learners construct their own unique concepts through active participation and meaning making

evaluation. the process of interpreting and making judgments about assessment information are the students learning what we want them to learn?

free-response question. (also referred to as open-ended question) any question for which there is more than one correct answer; usually such questions involve an explanation of the solution strategy.

hypermedia. a communications medium created by the convergence of computer and video technologies.

hypertext. a type of electronic cross reference providing an immediate connection at the click of a mouse.

implementation strategy. a method teachers use to help students develop the kinds of skills they will need to achieve a quality portfolio.

Internet. the superhighway of cyberspace: "Internet" refers to the global information system that is logically linked together by a globally unique address space based on the Internet Protocol (IP) and that provides, uses, or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure

metacognition. thinking about our thinking (the ability to self-reflect) is a higher-order cognitive skill.

neurobiology. branch of biology dealing with nerves and the nervous system.

neuroscience. any aspect of science dealing with nerves, parts of nerves, or the nervous system.

percentile rank score(s). a number or score indicating rank by telling what percentage of those being measured fell below that particular score.

performance standards. indices of quality that gauge the degree to which content standards have been attained.

progress criteria. standards by which a student's growth and progress are measured, progress criteria would be stated in relative terms the manner in which a student progresses from novice to basic or proficient.

rubrics. guides that give direction to the scoring of student products and/or performances, or standard guides.

software. the programs run on computers (the hardware).

testing. one of the tools of assessment; a measuring instrument used to document student learning.

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There are
one-story intellects,
two-story intellects, and three-story
intellects with skylights. All fact collectors, who
have no aim beyond their facts, are one-story men. Two-story men
compare, reason, generalize, using the labors of the fact collectors as
well as their own. Three-story men idealize, imagine,
predict—their best illumination comes from
above, through the skylight.

—Oliver Wendell
Holmes

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DIANE RONIS, PH.D.

Diane is a professor of education at Southern Connecticut State University and has a Ph.D. in curriculum and instruction. Her drive to make learning meaningful to all students comes from seventeen years of teaching. Diane is also the author of *Brain-Compatible Mathematics*.

SkyLight
PROFESSIONAL DEVELOPMENT
2626 S. Clearbrook Dr., Arlington Heights, IL 60005
800-348-4474 • 847-290-6600 • FAX 847-290-6609
info@skylightedu.com • www.skylightedu.com

ISBN 1-57517-168-6
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